ARCHIVES OF OPHTHALMOLOGY

VOLUME 21 (old series Volume 78) JANUARY 1939 NUMBER 1

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CORRECTION OF PTOSIS BY ATTACHMENT OF STRIPS OF ORBICULARIS MUSCLE TO THE SUPERIOR RECTUS MUSCLE

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In the surgical treatment of ptosis corrective effects are dependent on three different principles: (*a*) dependence on the attachment of the frontalis muscle to the lid by cicatricial bands, strips of skin, strips of orbicularis muscle and fascia lata; (*b*) shortening of the levator muscle of the upper lid by means of resection of the tarsus and resection or tucking of the levator muscle, or (*c*) dependence on elevation of the globe by means of the Motais operation and its modifications, the Young [1] operation, in which the upper lid is made to adhere to the globe, the Dickey [2] fascia lata sling or the Trainor [3] procedure, in which a strip of tarsus is passed under the superior rectus muscle.

Operations that depend for effect on the attachment of the lid to the frontalis muscle are not to be recommended for two chief reasons: First, the direction of pull is forward and upward instead of backward and upward, as is the case normally; and second, the elevation of the lid is accompanied by elevation of the brow and wrinkling of the forehead, with the effect of effort and strain.

Shortening of the levator muscle is the operation of choice if the ptosis is slight and if the lid has ability to move with the globe, even though the palpebral fissure may be too narrow. Resection of the levator muscle increases the effectiveness of its action.

The operations that cause the lid to follow the globe are necessary for drooping of the lid of considerable amount, if the lid does not tend to follow the elevation of the globe. In such a case the palpebral fissure may be actually narrower when the patient looks up than when he

† Dr. Wheeler died Aug. 22, 1938.

Read before the Section on Ophthalmology at the Eighty-Ninth Annual Session of the American Medical Association, San Francisco, June 15, 1938.

1. Young, G.: Operation for Congenital Ptosis, Brit. J. Ophth. **8**:272 (June) 1924.

2. Dickey, C. A.: Superior-Rectus Fascia-Lata Sling in the Correction of Ptosis, Am. J. Ophth. **19**:660 (Aug.) 1936.

3. Trainor, M. E.: Operation for Lid Ptosis, Tr. Sect. Ophth., A. M. A., 1935, p. 93.

looks down, for the margin of the lower lid may follow after the globe in its upward movement while the upper lid remains stationary.

The Motais operation, especially with modifications introduced by Shoemaker [4] and Kirby,[5] gives striking results, but it has four objections: First, there is a tendency toward angulation of the margin of the upper lid from the sharply localized attachment of the little strip of superior rectus muscle. Second, the superior rectus muscle is disturbed and injured. Third, the dissection entailed is considered difficult. Fourth, rarely, near the attachment of the superior rectus muscle to the upper lid entropion may occur and cilia rub on the cornea.

DESCRIPTION OF OPERATION

Anesthesia.—Avertin with the injection of procaine hydrochloride works well. The subcutaneous infiltration near the margin of the lid helps in the dissection because it magnifies the rather thin layer of the orbicularis muscle overlying the tarsus.

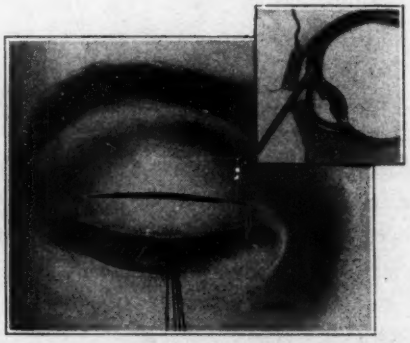

Fig. 1.—Primary incision. The inset attempts to show how the globe and the conjunctiva of the fornix are pulled down to facilitate the dissection.

The incision in the skin is made at the level of the upper border of the tarsus, and is about 25 mm. long (fig. 1).

The skin is dissected up from the orbicularis muscle nearly to the margin of the lid. (Care should be taken not to injure the cilia follicles.) The subcutaneous dissection is then carried upward about 10 mm.

A horizontal incision is made through the orbicularis muscle 4 or 5 mm. above the tarsus and carried through the tarso-orbital fascia and the levator tendon. Then the dissection is carried through Tenon's capsule to the sclera on each side of the tendon of the superior rectus muscle. This muscle is picked up on a squint hook, and its superior surface is exposed. During this dissection the globe is held in depression by a suture which has been passed through the conjunctiva and the superficial sclera just above the cornea. Another suture is carried through the conjunctiva of the upper fornix, and traction drags the upper cul-de-sac down out of the way of the dissection (fig. 1 inset and fig. 5).

4. Shoemaker, W. T.: Observations of the Motais Operation for Ptosis: Report of Three Cases, Ann. Ophth. **16**:608, 1907.

5. Kirby, D. B.: Modified Motais Operation for Blepharoptosis, Arch. Ophth. **57**:327 (July) 1928.

Strips of orbicularis muscle are dissected up from the surface of the tarsus. They are set free at the ends toward the canthi but are left attached at the ends toward the center of the lid. The attached ends are about 8 mm. apart, and the orbicularis muscle between is undisturbed. Each strip is about 10 mm. long and 4 mm. wide (fig. 3).

The strips of orbicularis muscle are attached to the upper surface of the superior rectus muscle with 000 chromic catgut. It is well for each strip to be attached by two sutures, as the strips have to carry a heavy load during the healing process when the upper lid is swollen.

Fig. 2.—The dissection above the tarsus has been carried through the orbicularis muscle, the tarso-orbital fascia, the levator muscle and Tenon's capsule. The superior rectus muscle is held on a hook.

Fig. 3.—Strips of orbicularis muscle 4 mm. wide and 10 mm. long are dissected up from the tarsus, and the ends toward the canthi are cut free. The attached ends are about 8 mm. apart.

An ordinary probe passed between the superior rectus muscle and the sclera and allowed to project out of the dissected area on each side is useful in steadying the globe in depression while the strips of orbicularis muscle are being attached.

After the orbicularis muscle is secured in contact with the superior rectus muscle, the only suturing required is that of the skin. This can be closed by several fine silk sutures or by a single subcutaneous suture.

Figure 4 shows the attachment of the strips of orbicularis muscle to the surface of the superior rectus muscle, and figure 5 shows the attachment in cross section.

Dressing.—Injury to the partially exposed cornea after operation must be avoided. The dressing should be such that the cornea is properly protected. For several years I have used a special dressing on account of lagophthalmos after the Motais type of operation, and this dressing can be recommended. A thin layer of absorbent cotton is dipped in warm water and then pressed almost dry between the palms of the hands. This is shaped to make a small cone, with the base large enough to cover the base of the orbit. The cone is filled with sterile petrolatum and placed over the eye and lids. Then another layer of moist

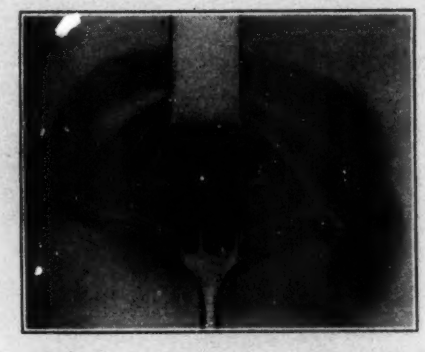

Fig. 4.—The strips of orbicularis muscle are attached to the superior rectus muscle with fine catgut.

Fig. 5.—Cross section to show attachment of the orbicularis muscle to the superior rectus muscle. The globe and the upper conjunctival cul-de-sac are held down by sutures.

cotton is placed over the cone with the overlapping joint in a position not corresponding with that of the first layer of the cone. Still a third thin layer is put over the cone. Strips of adhesive plaster are built up from the base to the apex of the cone, to hold it in place and to strengthen it. Even if a child should lie on such a dressing, it is secure enough protection so that nothing but petrolatum could touch the eye. This should be left on for about a week. After it is removed, petrolatum should be put in the palpebral fissure before the patient goes to sleep, as long as lagophthalmos persists.

COMMENT

In my experience with the operation there has been a tendency toward undercorrection, as there has been in other operations for ptosis. Probably a good rule is for the surgeon to leave the margin of the upper lid 2 or 3 mm. above the limbus at the close of the operation. In no case has there been overcorrection of the ptosis.

Moderate temporary lagophthalmos follows the operation and gradually disappears over a period of a few weeks.

A normal uninterrupted fold of skin develops in good position, with a covered crease at the line of incision along the upper border of the tarsus.

There is no tendency toward angulation of the margin of the lid from the pull of the two strips of orbicularis muscle, nor is any other deformity of the lid caused by the operation.

Impairment of elevation of the eyeball follows the operation, but as the postoperative reaction subsides the upward movement of the eyeball improves almost to normal.

Considerable swelling of the upper lid follows the operation, so that the eye may be almost closed for several days, but in no case has the attachment of the strips of orbicularis muscle to the superior rectus muscle been destroyed. As the swelling disappears, the movement of the upper lid develops.

The contour of the upper lid remains good, without a suggestion of angulation.

An objection to the operation is that the dissection might be considered difficult.

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ABSTRACT OF DISCUSSION

Dr. John O. McReynolds, Dallas, Texas: I have performed the operation as described by Dr. Wheeler with some modifications. I approach the tendon more directly in its place of attachment on the upper surface of the globe. After separating it freely from the bulb, I carry a strong silk thread under the tendon and use this bridle rein or halter rein as a substitute for the two threads that Dr. Wheeler introduced into the superior retrotarsal fold and into the episcleral tissue above the cornea. Then, instead of reaching down for the tendon through the cutaneous and fascial incision, I grasp the halter rein with a forceps and carry it upward through the incision until the superior rectus muscle presents in plain view through and above the incision.

Dr. Wheeler's operation does not involve section of any of the fibers of the superior rectus muscle and leaves the tendon in its entirety still attached to the globe with its power unimpaired. After the first postoperative day, the controlling suture in the upper lid can be

eliminated, and upward traction on the suture in the lower lid will be sufficient to keep the cornea covered and protected adequately by the updrawn lower lid.

Dr. John Weeks, Portland, Ore.: On a recent visit to New York I had the privilege of watching Dr. Wheeler perform his operation. Ptosis is usually congenital. It may be acquired and may or may not be associated with paresis or paralysis of the extraocular muscles. The operation desirable in any case depends on the conditions attending the individual patient. If the superior rectus muscle does not function, one must depend on attachment to the lower anterior border of the occipitofrontalis muscle to obtain movements of the upper lid. This may be done either by skin flaps, of which the Panas operation is an example, or by the use of portions of the orbicularis palpebrarum muscle, as was employed by the late Dr. Robert Reece. The portions of the orbicularis muscle raised by Dr. Reece were similar to those that were raised by Dr. Wheeler; the portions were carried under the skin to the anterior margin of the occipitofrontalis muscle and there attached. If pronounced movement of the lid is not necessary and the ptosis is not great, resection of the tendon of the levator muscle may suffice, or a shortening of the upper lid may be done after the manner of Gillet de Grandmont, by which procedure a widening of the palpebral fissure from 2 to 4 mm. may be obtained without endangering the closure of the eyes during sleep.

If the superior rectus muscle functions normally, the principle of attachment of the lid to this muscle may be satisfactorily applied, combined in cases in which the tissues of the lid are exceptionally heavy with removal of some of the tissue of the lid, or an undercorrection may be corrected by the operation of de Grandmont. The Motais operation has given good results in the cases in which I have applied it. The modification of the Motais operation by Shoemaker and by Kirby are valuable aids in the technic.

In the operation described by Dr. Wheeler the strips of orbicularis muscle were raised much as was done by Dr. Reece, but instead of being attached to the occipitofrontalis muscle, they were attached to the superior rectus muscle. The difficulties in technic are apparently about the same as in the Motais operation. If the power of the superior rectus muscle is better retained by the operation described by Dr. Wheeler than by the Motais operation, Dr. Wheeler's operation should be the one of choice.

Dr. C. A. Dickey, San Francisco: As the time is limited, I should like to show some slides of an operation I devised about four years ago. While I dissect out the superior rectus muscle, an assistant obtains a strip of fascia lata. The superior rectus muscle is isolated, and the central half of the muscle is separated. The fascial strip is inserted under the central half, and the capsule and conjunctiva are sutured with quadruple 0 catgut.

The incision is made in the lid as Dr. Wheeler does, and the tarsal plate is exposed fairly well down toward the margin of the lid. An incision is made at the upper border of the tarsus, and the strip of fascia lata is drawn through. Two white silk sutures are placed in the tarsus, one at the junction of the outer and the middle third of the

tarsus and the other at the junction of the inner and the middle third. One suture is passed through the fascia and tied. The length of the fascial sling required to produce the proper elevation of the lid is then estimated or, in other words, the length of the sling determines the position of the lid. When this is decided, the fascia is tied down to the tarsus, and the incision in the skin is closed with a subcuticular stitch.

The advantages of this procedure are that any degree of elevation may be obtained, and in the event of a failure the operation may be repeated easily, as there has been no damage done either to the superior rectus muscle or to the lid. Also, the full action of the superior rectus muscle is utilized, as Dr. Jackson pointed out when I first presented this procedure three years ago.

DR. W. D. HORNER, San Francisco: Dr. Wheeler and Dr. Dickey apparently have presented a good substitute for the Motais operation, which, while an old favorite, has certain defects, which Dr. Wheeler pointed out. The new operations correct these difficulties by a substitution of a two point suspension of the lid instead of the one offered by the Motais. There is no permanent damage to the superior rectus muscle by either. This means a good deal, because not every operation for ptosis gives satisfactory results, and sometimes it is necessary or worth while to operate a second time. This can be done, I think, with either method.

My interest in Dr. Dickey's operation has been keen, naturally, because it was developed at the ophthalmic clinic of the University of California Medical School, and I have had the opportunity of seeing him work and also have had the opportunity of doing the operation myself. I have performed the operation in about 20 cases altogether, and the results have been satisfactory. One, however, must remember that all textbooks end up or begin the discussion of ptosis with the words that operative treatment of ptosis is inherently difficult.

DR. JOHN M. WHEELER, New York: I am pleased that Dr. McReynolds considered my operation important enough to modify it. I think that there may be certain advantages in keeping out of the conjunctival sac, so that personally I should prefer to operate through the sort of incision that I have made.

Dr. Dickey's operation is interesting, but I have not performed it. I should think that the results would be much the same with the two procedures, but in doing his operation I think that an unnecessary dissection is made in the thigh. If suitable material can be found in the lid, it seems as though it would be preferable for the surgeon to use such material. Dr. Dickey in an article in which he described his operation spoke of the fascia lata giving way in 1 case, and I think that in that case the fascia had been preserved. Evidently now he believes that a dissection in the thigh should be made in order to obtain the tissue necessary for suspension.

I should like to repeat that in case the eyelid makes a worthy attempt to go up with the eyeball, I should not recommend this operation but suggest increasing the effectiveness of the levator muscle by shortening it. This operation, I think, should be done only in case the lid fails entirely to go up with the eyeball.

ROLE OF NONVIOLENCE IN LEVER ACTION INTRACAPSULAR EXTRACTION OF CATARACT

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Since the publication of my article on the lever action operation for the intracapsular extraction of cataract in the ARCHIVES [1] letters of inquiry about further particulars of this method and the special instruments employed, viz., the hyalonavicular fulcrum and the mango leaf dislocator, have been received. In the previous article the scientific principle of lever action and its technical application to the extraction of cataract intracapsularly were described. It now remains to explain what makes this method safer, surer and at the same time simpler than capsulotomy and the other intracapsular methods. The secret of success of the intracapsular extraction of cataract by the lever action technic lies in the adaptation of the principle of nonviolence in its performance—thanks to Mahatma Gandhi, whose principle of nonviolence is applicable to cataract extractions even more appropriately than to political movements. The reason for the success of nonviolence in cataract extraction has been well expressed by J. W. Wright: [2] "There is no organ of the entire body so sensitively adjusted comparable to the eye, being composed of various intricate structures liberally supplied by one-half of the cranial nerves" (from the second to the seventh cranial nerve) and, moreover, "each structure is endowed with functional activities" of a delicate nature which are impaired by the slightest trauma, ectopia or irritation or inflammation of the sensitive structures. Who can doubt that an operation for the extraction of cataract on such a delicate and sensitive organ should be strictly nonviolent in order to insure that no trauma or irritation is done at the time of operation and that no inflammatory reaction follows? Nowadays, irritation, trauma, ectopia and mutilation are more or less enacted under cover of local anesthesia, facial akinesia and retrobulbar anesthesia in all the ingenious and complicated modern methods of cataract extraction. Though the anesthetized eye seems to feel the same at the time of operation, the postoperative results prove that these irritations are not to be tolerated with impunity by this most delicate and sensitive organ of the body. Hence, what

1. Dutt, K. C.: Lever Action Operation for Intracapsular Extraction of Cataract, Arch. Ophth. **18**:897 (Dec.) 1937.
2. Wright, J. W.: Columbus M. J. **3**:145, 1884.

is often found in such cases is the striking paradox of a most successful extraction of cataract by ingenious instrumentation and ultimate results which are not successful. This fact is too significant to be overlooked. What is the lesson it carries? Colonel Smith's [3] experience and observation point to the reason. Smith [3e] wrote: "As a matter of fact the outer surface of the cornea will tolerate any amount of massaging without showing any reaction. It is the under surface which is intolerant of instrumentation. Hence other things being equal, the less we introduce instruments into the eye the better." To insure successful results and an uneventful postoperative period, lever action intracapsular technic, among other things, observes strict nonviolence to the eye and especially to its internal structures. But regardless of how delicate the operative technic is, there is always the problem of trauma to the tissue. Lever action has solved this difficult problem so far as is possible and has worked out the irreducible minimum of violence required for the extraction of cataract. In ordinary cases this technic consists of (1) a limbic incision into the upper half of the sclerocorneal arc and (2) delivery of the lens in its capsule by lever action with a minimum of force or effort, applied from the outer surface of the eye. In such cases iridectomy has been eliminated and prolapse of the iris prevented by postural treatment. The scientific principle of lever action has been applied so as to insure a mechanical advantage by which much less effort is required to dislocate and rotate the lens in capsule and still less is required for the detachment of the zonule than the actual strength of anchorage of the zonule. As this minimum of effort is applied from the outer surface of the eye and in a direction forward and upward away from the vitreous and other internal structures of the eye, the objective of an irreducible minimum of violence has been attained. Consequently, lever action intracapsular extraction is universally applicable to all the varieties of cataract in all the stages of formation and with varying degrees of strength of attachment of their zonules without risk of loss of vitreous or rupture of the capsule.

W. A. Fisher [4] in his article on senile cataract stated: "The intracapsular operation for senile cataract is becoming daily more popular and operators are looking for a method whereby vitreous loss and ruptured capsules together with other complications due to these accidents will be reduced to a minimum." Indeed, the time is fast approaching when neither the patient nor the surgeon can afford to wait for

3. Smith, H.: (*a*) Arch. Ophth. **33**:64, 1904; (*b*) **55**:213, 1926; (*c*) Tr. Ophth. Soc. U. Kingdom **45**:123, 1925; (*d*) Ophth. Rec. **19**:54, 1910; (*e*) Treatment of Cataract and Some Other Common Ocular Affections, ed. 2, London, Butterworth & Company, 1928, p. 167.

4. Fisher, W. A.: Senile Cataract: Methods of Operating, ed. 3, Chicago, H. G. Adair Printing Co., 1937, p. 134.

the indefinite periods necessary for the ripening of different varieties of cataract. Consequently, as soon as, or soon after, useful vision is lost the cataract should be extracted. Therefore, either the cataract is extracted intracapsularly or capsulotomy is performed before the cataract is fully mature. But capsulotomy performed during immaturity of the cataract renders the expression of the cortical matter of the lens difficult, even after repeated irrigation of the anterior chamber. The new additions to the technic of capsulotomy, viz., many bizarre incisions in the capsule; preliminary capsulotomy; opening the capsule with a sharp-toothed forceps or with a blunt-toothed forceps; conjunctival flaps; conjunctival sutures; corneal, corneoconjunctival, corneoscleral and conjunctivoscleral sutures with facial akinesia and retrobulbar anesthesia; bridal sutures, and irrigation of the anterior chamber by means of various types of irrigators and different lotions, have not yielded better results than the original technic of Daviel. Early extraction in the premature stage, combined with the aforementioned complicated and prolonged operations, acts rather adversely, by the formation of iritis and an after-cataract which is too dense to be dealt with by needling. Hence, the needling has to be repeated. But repeated needling is likely to give rise to endophthalmitis phacoanaphylactica due to the distintegration of lens protein which acts as foreign matter and as a toxin. Thus, Fisher [5] wrote: "Needling operations are considered by many as being quite dangerous, always leaving a hernia of the vitreous, and are often followed by post-operative inflammations and too often by inflammation with great danger of serious loss of vision." Smith [6] in his book on the treatment of cataract stated: "For the surgeon who extracts cataract by capsulotomy is now-a-days forced by the pressure of competition to extend his sphere of action to the immature stage. The density and toughness of the after-cataract which ensues drive him to needle it while it is still young and tender, before the eye has lost its intolerance to further operative interference and has recovered a stable equilibrium." Hence, "sudden disasters which frequently destroy the eye" follow.

In this connection, Duke-Elder [7] stated: "It is well known that after an extracapsular extraction of cataract, especially when a considerable quantity of lens material is left in the eye, an iritis, sometimes of considerable severity, is commonplace. The theory that the reaction in the eye is due to an anaphylactic reaction to the lens proteins is already well known from the work of Burky and Woods,[8] as is also

5. Fisher,[4] p. 136.

6. Smith,[3e] p. 188.

7. Duke-Elder, S., in Tidy, H. L., and Short, A. R.: Medical Annual, Bristol, England, John Wright & Sons, Ltd., 1936, p. 112.

8. Burky, E. L., and Woods, A. C.: Lens Extract: Its Preparation and Clinical Use, Arch. Ophth. 6:548 (Oct.) 1931.

their suggestion that sensitive patients should be desensitized before an operation is undertaken." Efforts have been made by Goodman[9] to minimize anaphylactic reaction by previous injections of graduated doses of lens protein.

In spite of the aforementioned recent advances toward the improvement of capsulotomy and its after-effects, i. e., postoperative inflammation of the iris and ciliary body, blurred vision, preliminary injections of lens protein, formation of after-cataracts, risks of repeated needling, sensitization and irritability of the eye, all these drawback still remain as stumbling blocks to the universal application of this method for the extraction of cataract. In addition, there are hard cataracts with such thick capsules that they cannot be properly cut with the cystitome. These short-comings attend capsulotomy regardless of all attempts to remedy them. The newer additions to the technic have rather added to the complications and made matters worse than before.

On the other hand, many ophthalmic surgeons in India, America and Europe have acquired skill and experience with the different methods of intracapsular operation and have established their name and fame with the operation of their choice. This is especially practicable now because the old prejudices and apprehensions against any of the intracapsular methods no longer exist. Each intracapsular method is put to practice by every up-to-date ophthalmic surgeon in suitable cases.

Formerly, some advocates of extraction by capsulotomy contended that the after-effects of intracapsular extraction were not good. In order to find out the truth of this assertion, some eminent surgeons took pains to investigate carefully the end results in cases in which intracapsular extraction was used.

The investigations and observations were carried on by Lister,[10] Knapp,[11] Fuchs, Fisher,[12] Pratt,[13] Greene,[14] Greene and Millette,[15]

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9. Goodman, E. L.: Endophthalmitis Phaco-Anaphylactica, Arch. Ophth. **14**: 90 (July) 1935.

10. Lister, A. E. J., in Smith,[3e] pp. 242-258.

11. Knapp, A.: Arch. Ophth. **44**:1, 1915; Tr. Ophth. Soc. U. Kingdom **45**: 117, 1925.

12. Fisher, W. A.: Arch. Ophth. **44**:18, 1915; J. Ophth. & Oto-Laryng. **4**:379, 1910; Ophthalmology **11**:318, 1915; Ann. Ophth. **24**:718, 1915; **26**:79, 1917.

13. Pratt, F. J., and Pratt, J. A.: Minnesota Med. **4**:370, 1921.

14. Greene, D. W.: Intracapsular Extraction of Cataract, in Wood, C. A.: American Encyclopedia and Dictionary of Ophthalmology, Chicago, Cleveland Press, 1914, vol. 3, p. 1533; Experience in the Expression of Cataracts in the Capsule by the Smith Method, Tr. Sect. Ophth., A. M. A., 1909, p. 177.

15. Greene, D. W., and Millette, J. W.: Visual Results After the Smith Operation for Cataract, J. A. M. A. **59**:1070 (Sept. 21) 1912.

Elschnig [16] and others in cases in which Smith's pressure method and the Knapp-Török [17]-Elschnig method, which employed traction with a forceps combined with pressure, were used. The results of their investigations have definitely proved that removal of the posterior capsule does not produce degenerative changes in the vitreous, or glaucoma or detachment of the retina.

Again, a systematic follow-up study and a minute investigation of the end results were carried out by Vail,[18] A. S. and L. D. Green,[19] Urra,[20] Cruickshank,[21] Cadilhac,[22] Saint-Martin,[23] Wright [24] and others in cases in which intracapsular extraction was done by Barraquer's vacuum suction method and by vacuum suction combined with pressure. The results of these investigations have established the facts that there are few complications and that the vitreous gel does not show opacities or any other pathologic change afterward.

These truth-seekers have done a great service to suffering humanity by removing the apprehensions of opacification or degeneration of the vitreous at a later date after intracapsular extraction of cataract and by proving that the after-complications are fewer than after extraction by capsulotomy.

It has therefore been possible for the surgeon to operate by any of the intracapsular methods as may be deemed suitable in a particular case. The patient has also been relieved of the anxiety about the after-complications and can now implicitly rely on the discretion and judgment of the surgeon as to the selection of the method of operation.

Although the prejudices and the apprehensions against intracapsular extraction have been removed, why is it that this method cannot be universally applicable? Duke-Elder [25] cleared up this point in his textbook on the recent advances in ophthalmology: "In these days, newer and more complicated procedures are being devised and advocated for the operative technique of the extraction of cataract, all of them intro-

16. Elschnig, A.: Die intrakapsulare Starextrakation, ed. 2 and 3, Berlin, Julius Springer, 1932; Ztschr. f. Augenh. **75**:1, 1931; Am. J. Ophth. **8**:355, 1925.

17. Török, E.: Ann. Ophth. **25**:712, 1916.

18. Vail, D. T.: Ophth. Rec. **24**:248, 1915; Arch. Ophth. **45**:307, 1916.

19. Green, A. S., and Green, L. D.: Intracapsular Extraction of Senile Cataract, Tr. Sect. Ophth., A. M. A., 1917, p. 313; Am. J. Ophth. **5**:92, 1922; Arch. Ophth. **51**:338, 1922.

20. Urra, M.: España oftal. **6**:101, 1921.

21. Cruickshank, M. M.: Brit. J. Ophth. **9**:321, 1925.

22. Cadilhac, G.: L'extraction totale de la cataracte par l'erisiphaque, Paris, Masson & Cie, 1930.

23. Saint-Martin, cited by Cadilhac.[22]

24. Wright, R. E.: Am. J. Ophth. **7**:155, 1924.

25. Duke-Elder, S.: Recent Advances in Ophthalmology, ed. 3, Philadelphia, P. Blakiston's Son & Co., 1934.

ducing more manipulative difficulties at the time of operation and most of them more dangerous afterwards." No doubt Duke-Elder had the right idea. Indeed, the tendency toward devising complicated procedures and inventing complicated instruments for the performance of cataract extraction has proved to be unprofitable in the long run, so far as the end results of the operation are concerned. More and more ingenious and complicated instruments are finding a place in the list of new inventions. Barraquer's [26] erisphake, invented in 1917, is really an ingenious and complicated instrument with complicated machinery which is difficult to work at a constant vacuum negative pressure during the whole period of the operation. Sometimes, the erisphake gets out of order in the middle of the operation. Moreover, when it is out of order the instrument cannot be readjusted immediately, because it is too hot to handle at that time. Lacarrère's [27] diathermic coagulation needle, invented in 1932, is even more ingenious and more difficult to control. It requires much skill to insure that only the necessary degree of coagulation of the lens protein is effected and that coagulation of the underlying vitreous is not accidentally done. The technics of these operations as well as those of the other combined and complicated methods look well on paper and also display the skill and dexterity of the surgeon at the time of operation, but when the time for reckoning comes the results belie all sanguine expectations. The end results are far from satisfactory! All the labor is lost!

Is it not time to call a halt to the further invention of complicated technics and ingenious instruments? Would it not be better to invent simpler instruments which can never get out of order, which will work from the outside and which will inflict no violence and will not irritate the delicate internal structures of the eye? Would it not be better to devise a method which is technically easy for the surgeon, scientifically advantageous and profitable and practically easy for the eye to bear? Is it not better to devise a technic which is universally applicable to all forms of cataract in all the stages of formation without fail—a technic which is free from the risk of the surgeon having to revert to capsulotomy in the middle of the operation; which is free from the risk of loss of vitreous and rupture of the capsule at the time of its performance, and which is free from risk of postoperative inflammation? All the aforementioned conditions have been satisfied by the lever action intracapsular technic.

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26. Barraquer, I.: (*a*) Brit. M. J. **2**:660, 1924; (*b*) Arch. de oftal. hispano-am. **17**:252, 1917; (*c*) Arch. Ophth. **50**:307, 1921; (*d*) **51**:448, 1922; (*e*) Facoerisis, in Fisher,[4] p. 8.

27. Lacarrère, J. L.: Klin. Monatsbl. f. Augenh. **88**:778, 1932; Arch. de oftal. hispano-am. **32**:293, 1932.

The scientific basis of the lever action intracapsular operation renders the technic safer and surer than the application of the force by expression, as with capsulotomy, or by pressure, by suction, by traction or a combination of these forces, as with the intracapsular methods. This is because lever action acts at a mechanical advantage which is always greater than the original force employed and therefore is always mechanically more advantageous and profitable than any of the other methods. It has been proved by mathematical equations in my previous article [1] on this operation that the resulting available power for the dislocation and rotation of the lens-in-capsule and for the detachment of the zonule is always greater than the power originally employed by the surgeon's hand. This advantage of "profit of power" which characterizes the lever action intracapsular method is not available with capsulotomy, in which the power employed consists of expression, or with any of the intracapsular methods, in which the power employed consists of pressure, suction, traction, suction with pressure or traction with pressure. This makes lever action safer and surer and at the same time easier and more profitable than all other methods of cataract extraction, capsulotomy or intracapsular extraction.

Moreover, lever action is performed by instruments which are simple in their construction, really imitations of nature in their formation, are easy to manipulate and never get out of order. The mango leaf dislocator, the hyalonavicular fulcrum and the stirrup eyelid retractors will find favor with any surgeon who pleases to practice with them.[28] Photographs of these instruments appeared in my previous article.[29]

It is to be especially noted that the hyalonavicular fulcrum is a double-headed silver instrument. In fact, two fulcrum instruments, viz., the hyaloid socket fulcrum and the navicular socket fulcrum, have been combined in the double head, which is the part of the instrument that does the work. Both the socket fulcrums have been made in imitation of nature. The hyaloid socket has been made in imitation of the hyaloid fossa in the vitreous, and the navicular socket, in imitation of a 5 mm. section of the curve of the socket within the ciliary body into which the equator of the lens-in-capsule is socketed by nature. The reason for this combination is as follows: If two separate instruments, the hyaloid socket fulcrum and the navicular socket fulcrum, were made, the operator would be considerably inconvenienced, because the 12 o'clock upper convex border of the equator of the lens-in-capsule is socketed into the concavity of the navicular socket fulcrum during the first and second stages of the operation, viz., stage I, consisting of dis-

28. These instruments may be obtained from Down Bros., Ltd., London.

29. Dutt,[1] p. 900, fig. 2.

location of the lens-in-capsule, and stage II, consisting of rotation of the lens-in-capsule. The reader is referred to my previous article for a diagram illustrating stage I.[30]

The concavity of the navicular socket fulcrum is kept applied to this portion of the lens-in-capsule during stage II of the operation. A diagram illustrating this stage was also reproduced in my previous article.[31]

During stage III, that of detachment of the zonule, the convexity of the anterior surface of the lens-in-capsule is socketed within the concavity of the hyaloid fulcrum. If two instruments were used, the second instrument, the hyaloid socket fulcrum, would have to be taken from the instrument tray. This change of instrument in the middle of the operation would necessitate postponement of the operation for the time being. To obviate this postponement when the operation is half done, the combined double-headed instrument was devised and is used with convenience. A diagram illustrating stage III is to be found in my previous article.[32]

As soon as the second stage of rotation of the lens-in-capsule is over, the surgeon has only to turn the combined instrument, i. e., the hyalonavicular fulcrum, between his thumb on one side and the other fingers on the other side in order to change the navicular socket fulcrum and to engage the hyaloid socket fulcrum. This simple maneuver at once engages the anterior pole and the anterior surface of the lens-in-

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30. Dutt,[1] p. 901, fig. 3. In this diagram are shown the navicular fulcrum, applied at 12 o'clock outside the sclera; effort or power applied with the tip of the mango leaf dislocator at 6 o'clock, outside the sclera, and points of resistance (*R* and *R'*) of the zonule to be overcome, inside on each side of 6 o'clock. By this procedure the more or less rigid cataractous lens-in-capsule is converted into a lever. In this lever the resistance of the zonule is placed between the fulcrum and the effort; hence, a lever of class II is formed. A diagram illustrating this lever appears on page 898 of the article just mentioned.

31. Dutt, p. 902, fig. 4. In this illustration are shown the navicular fulcrum applied at 12 o'clock, socketing the upper border of the lens-in-capsule; effort applied steadily forward by insinuating the tip of the mango leaf dislocator at 6 o'clock on the breach of the zonule from the outside to hitch the lower posterior border of the equator of the lens-in-capsule so as to tilt it forward, and the points of resistance (*RR'*) in the attachment of the zonule. When *RR'* give way, the resistance recedes to points *R'' R'''* in the zonular attachment. The lower border of the lens-in-capsule is rotated gradually forward and upward as more and more of the zonule is peeled off.

32. Dutt,[1] p. 903, fig. 5. This illustration shows the hyaloid socket fulcrum applied at 12 o'clock and the bend of the mango leaf dislocator applied behind and below the lower border of the lens-in-capsule. The remaining portion of the zonule from 6 to 12 o'clock from the points of resistance *R'' R'''* up to 12 o'clock is detached gradually as the cataractous lens-in-capsule turns on the hyaloid socket fulcrum.

capsule within the hyaloid socket of the hyalonavicular fulcrum. The anterior convex surface of the lens-in-capsule automatically fits into the hyaloid socket nicely and cannot slip out. The lens is hereafter conveniently held between the hyaloid socket fulcrum on the anterior side and the bend of the mango leaf dislocator on its posterior side.

As has been stated previously, the navicular socket fulcrum has been made in imitation of a 5 mm. section of the curve within the ciliary body into which the equator of the lens-in-capsule is socketed by nature. The navicular socket is carved longitudinally on one face of the head of the hyalonavicular fulcrum. The socket is a boat-shaped furrow about 0.5 mm. in depth in the central part, while the two sides gradually diverge and form the crest. Thus, a shallow concavity is formed. When the navicular socket fulcrum is placed horizontally and tangentially to the optic globe at 12 o'clock on its surface, the convex upper border of the lens-in-capsule at its equator is socketed within the navicular socket fulcrum, padded by the sclera. The convex upper border of the equator of the lens-in-capsule may thus freely turn within the navicular socket fulcrum in a hingelike fashion and cannot slip out.

The hyaloid socket, which is made in imitation of the shape and size of the hyaloid fossa of the vitreous, consequently presents a uniformly round and hyaloid-fossa-like concavity about 0.5 mm. in depth and 5 mm. in diameter. It may be here noted that the hyaloid fossa of the vitreous accommodates the posterior convex surface of the lens-in-capsule, whereas the hyaloid socket fulcrum is intended to accommodate the anterior convex surface. But it is an anatomic fact that the anterior surface of the lens-in-capsule is a bit less convex than the posterior surface. Accordingly, the hyaloid-fossa-like concavity of the hyalonavicular fulcrum is a bit less concave than the hyaloid fossa of the vitreous. When in action during the third stage of detachment of the zonule, the hyaloid socket fulcrum accommodates the anterior convex surface of the lens-in-capsule so as to form something like a ball and socket joint fulcrum into which the anterior convex surface of the lens can freely turn by lever action.

The mango leaf dislocator is a blut-pointed, lanceolate, leaf-shaped instrument, 4 by 3 by 1 mm., tipped with silver. There is a bend in the rod of the instrument in the petiole extending from the base of the leaf. The bend is a rounded angle of 90 degrees and extends for about 1 cm. from the base of the leaf. The blunt tip of the leaf is used from the outer surface of the eye and is nonpenetrating. This tip comes into action during the first stage of the operation and is used to impart delicate fish-angling jerks to the 6 o'clock border of the equator of the lens-in-capsule.[20] These fish-angling jerks are imparted in a forward and upward direction away from the vitreous. The tip of the dislocator

hitches and imparts these delicate jerks to the posterior lower border of the equator of the lens-in-capsule at 6 o'clock from the outer surface of the sclera, till a breach of about 2 mm. is effected in the zonule at 6 o'clock.

The tip with the adjoining portion of the leaf-shaped span comes into action during the second stage of the operation (fig. 1). The tip with the contiguous portion of the leaf-shaped span is insinuated into the breach of the zonule and below the lower border of the equator of the lens-in-capsule, padded by the cornea. The tip and span are used to give steady forward and upward tilting effort. The lower border of the lens-in-capsule is thus slowly and steadily rotated forward and upward, while the resistance of the attachment of the zonule gives way by lever action gradually from below upward.[21] After the lower border of the lens-in-capsule has rotated forward and upward up to 45 degrees, it clears itself out of the attached lower half of the cornea, and the second stage of the operation ends.

The bend of the mango leaf dislocator comes into action during the third stage of the operation. The hyaloid fulcrum acts as a socket fulcrum during this stage to accommodate the anterior surface of the lens-in-capsule within the hyaloid socket.[22] The bend of the mango leaf dislocator is hooked below and behind the posterior surface of the lens-in-capsule, while the anterior surface is socketed into the hyaloid fulcrum. By a final delicate turning movement of the mango leaf dislocator forward and upward, the detachment of the attached upper half of the zonule from below upward to 12 o'clock is completed without much effort. The advantage afforded by lever action is great during the third stage. The lens-in-capsule is therefore delivered without any appreciable effort.

But, in order that the lens-in-capsule may be rotated and delivered without any obstruction, it is necessary that the incision in the sclerocornea be sufficient for the passage of lens. Some surgeons recommend that the incision extend over two fifths of the corneal circumference, while others recommend that it extend over three fifths.

The safe delivery of the lens-in-capsule depends on proper limbic section, which must be sufficiently large to allow for the passage of the lens-in-capsule. Also the proper nutrition of the limbic flap after operation depends on proper limbic section, which should not be inordinately large. If the incision is too large, delivery will be easy, but the cornea will be hazy due to malnutrition. What is the proper corneal section, then, that meets both requirements?

It is a geometric fact that the diameter at 180 degrees is the broadest part of a circle. The equator of the lens-in-capsule is circular. The

socket within the ciliary body into which the equator of the lens-in-capsule is accurately socketed is also circular. But, the cornea fits on the sclerotic like the crystal of a watch. Therefore, the circumference at the base of the cornea is just a little narrower than the equator of the lens-in-capsule. In order that the largest diameter of the lens-in-capsule may safely be delivered, the points of puncture and counter-puncture should be chosen a little outside the limbic arc at its broadest diameter at 180 degrees. The point of the cataract knife on entry may pass through a bit of conjunctiva before piercing the coats of the eye, just a little outside the sclerocorneal junction; and again the counter-puncture should be just a little outside the sclerocorneal junction, emerging with a bit of conjunctival flap. This will insure a broad base with a bit of conjunctival flap, and at the same time the incision will not be too near the filtration angle and the ciliary body. After emergence at the counterpuncture, the knife should be steered to the line of the limbic arc and so also at the puncture, when the incision on that side is begun.

In this connection, the views expressed in 1868 by McNamara,[33] professor at Calcutta Medical College, about making the flap for intracapsular extraction are worth quoting: "In making the flap we must keep slightly external to the margin of the cornea so as to leave as large an opening as possible through which the lens may escape, its bulk when contained within the capsule being considerable."

Unlike capsulotomy, the whole of the lens-in-capsule is extracted with the lever action intracapsular operation. Therefore, an incision extending over the upper half of the circumference of the limbus with a broad base will make an outlet which will allow the lens-in-capsule to pass during its delivery without risk of rupture of the capsule or without undue application of force or violence. At the same time, there is no risk of the corneal flap suffering from malnutrition.

J. W. Wright[2] advised that the section be made one third of the corneal circumference, and Barraquer[26e] stated that it should be made two fifths of the sclerocorneal circumference with a small-tongued conjunctival flap at its middle third. The lens-in-capsule can be delivered through these passages, which are slightly less than half the corneal circumference, but only if the two following conditions are satisfied. It has been mathematically proved that an incision including half the circumference of the limbic arc plus a broader base is necessary for the passage of the broadest diameter of the equator of the lens-in-capsule. It is therefore necessary for the safe delivery of the lens-in-capsule through a passage of one-third or two-fifths the circumference

33. McNamara, N. C.: Lectures on Diseases of the Eye, London, J. Churchill & Sons, 1868.

of the limbic arc that (1) the passage should dilate sufficiently or (2) the lens-in-capsule should undergo necessary molding. It may be that both dilatation of the passage and molding of the lens-in-capsule may go on hand in hand in the process of delivery. But there are cases in which with every effort delivery cannot be effected through small passages. In such cases the base of the incision has to be enlarged to effect safe delivery. The reason is that the cornea of senile persons is more or less sclerosed and does not as a rule dilate much. Moreover, a very hard cataract with a large lens and little cortical matter does not admit of much molding. To try to force a delivery under the foregoing conditions through a passage less than half the circumference of the limbic arc will necessitate much violence with the attendant risks. Again, in soft cataracts with thin capsules, such as the morgagnian or the intumescent variety, the thin capsules are liable to burst when undergoing excessive molding. It is better to take no risk but to make the incision half the circumference of the limbic arc at the outset and thus insure nonviolence and safe delivery of the lens-in-capsule.

On the other hand, if the section is made three fifths of the circumference of the limbic arc then so far as the nutrition of the corneal flap is concerned one is on the borderline of safety. For the first few days after operation the incised corneal flap depends for its nutrition on the supply of lymph that reaches it through the lymph channels of the attached portion of the cornea. Thus, if the incision is larger than three fifths of the circumference of the limbic arc the nutrition is insufficient. If the incision is just three fifths of the circumference, the nutriment that reaches the flap may be sufficient in healthy persons. But when one considers that for safe delivery of the lens-in-capsule an incision larger than one half of the circumference of the limbic arc is unnecessary, why then go to the extreme limit of safety, i. e., why make an incision three fifths of the circumference? In case of a bad cornea in a senile and debilitated patient there is risk of a corneal opacity with a flap even three fifths of the circumference of the limbic arc. Why take such an unnecessary risk?

Thus, with corneal flaps less than half the circumference of the limbus, as recommended by J. W. Wright[2] and by Barraquer,[26e] there is greater chance of a supply of nutriment to the incised corneal flaps; however this little advantage is more than counterbalanced by the risk of traumatic delivery in cases of hard cataract with large nuclei and by the risk of rupture of the thin capsules in cases of soft cataract. It is far better to admit the mathematical truth by making the corneal flap half the circumference of the limbus; delivery of the lens-in-capsule with nonviolence and without obstruction at the outlet is thereby insured.

It is better to include small bits of conjunctiva at the puncture and at the counterpuncture. Again, a small conjunctival flap at the termination at 12 o'clock is also useful. A thin layer of subconjunctival tissue underneath the conjunctival flap will prevent it from drying up like parchment and insure its agglutination with the episcleral raw cut within six hours after operation. These measures will open up new channels for the nutrition of the corneal flap after three days and keep the margins of the wound in the apposition necessary for healing by primary intention. Special dietetic measures for insuring nutrition of the corneal flap will be discussed in a future article. In view of all the foregoing facts, an incision in the limbus extending over the upper half of the sclerocornea, terminating in a small conjunctival flap at 12 o'clock and having a broad base covered with small bits of conjunctiva attached thereto, is advisedly made in the lever action intracapsular method, which involves no risks.

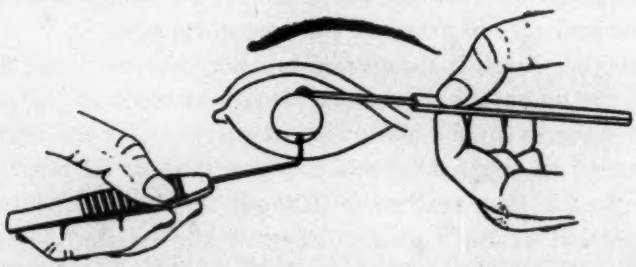

Fig. 1.—Diagram illustrating stage I and stage II of the operation. The hyalonavicular fulcrum is held by the unused hand with the thumb on one side and the other four fingers on the other side of the handle. It is applied horizontally and tangentially to the optic globe, socketing the upper equatorial border within the navicular fulcrum.

The mango leaf dislocator is held perpendicularly by the best hand with the thumb on the side of the handle continuous with the concavity of the band and the index and middle fingers on the side of the convexity. The tip and concavity of the mango leaf point forward and upward.

STAGE I: DISLOCATION OF THE LENS IN ITS CAPSULE

After the incision is made in the limbus, the lens-in-capsule is delivered by lever action. This is done in three stages. The first stage consists of dislocation of the lens-in-capsule.[30] In this stage, the attachment of the zonule is to be breached over a small area about 2 mm. near 6 o'clock. To perform this, the navicular socket of the hyalonavicular fulcrum is fixed at 12 o'clock, engaging the upper border of the equator of the lens-in-capsule, padded by the sclera. For operation on either eye the hyalonavicular fulcrum is held in the left hand of a right-handed surgeon (fig. 1) and in the right hand of a left-handed

surgeon with the thumb on one side of the handle and the remaining four fingers on the other side. The operator should change his position, standing where it is most convenient according to the eye on which he is operating. The upper border of the equator of the lens-in-capsule at 12 o'clock is just behind the attachment of the iris, which is visible through the incision at 12 o'clock. There is therefore no difficulty in finding it and socketing it into the navicular fulcrum.

The mango leaf dislocator is held in the right hand of a right-handed surgeon with the thumb on one side of the handle and the index and middle fingers on the other side. The hold of the thumb should be on the side of the handle which is continuous with the concavity of the bend of the rod, or the petiolar portion of the leaf. The index and middle fingers should be placed on the handle opposite to the thumb; they are placed, therefore, on the side of the handle which is continuous with the convexity of the bend, or the petiolar portion of the leaf. The instrument is held in the left hand in case the surgeon is left handed. The best hand is to be taken advantage of in the act of giving the least jerky efforts with the tip of the mango leaf dislocator to the lower and posterior border of the equator of the lens-in-capsule at 6 o'clock. Ambidexterity need not be acquired. The surgeon is at liberty to change his position of standing as required. He may take his stand at the head of the table (fig. 1) or at the right side or at the left side of the patient as is convenient.

To locate the position of the equator of the encapsuled lens at 6 o'clock from the outer side of the sclera, the tip of the mango leaf dislocator may be passed over the surface of the sclera from behind forward toward the limbus at 6 o'clock. At the line of attachment of the equator, which is generally about 3 mm. outside the limbic arc, some resistance is felt by the tip of the dislocator. However, it does not matter much if the curve of the attachment of the equator deviates a little to this or that side of the usual place, or even if its resistance may not be well felt by the surgeon. The tip of the mango leaf dislocator automatically hitches the lower border of the equator of the lens-in-capsule, whether it is at 3 mm. outside the limbus or a little anteriorly or posteriorly. This is because the fish-angling jerks are given from behind forward and below upward over the surface of the sclera toward the limbus at 6 o'clock. There is nothing else there to offer resistance to the tip of the mango leaf dislocator except the border of the equator of the encapsuled lens. Therefore, the tip of the dislocator cannot help but hitch the lower border of the equator when the operator jerks it at about its attachment. The only thing that is imperatively necessary is to give delicate jerks. If violent jerks are given, the encapsuled cataractous lens will be violently shot out; because lever action enhances the force or effort originally applied, forceful jerks act more violently.

What is wanted is only a small breach of about 2 mm. in the zonule at 6 o'clock. For this purpose, delicate jerks only are required. Since the operation is to be nonviolent, how can the violent jerks be avoided? The delicacy of the jerks can be insured if the flexor muscles of the index and middle fingers only are used in giving the jerks and not the muscles of he hand. These delicate jerks should be repeated until the desired breach in the zonule is effected. Then the second stage of rotation begins.

The number of fish-angling jerks required for making a small breach in the zonule is variable, because the strength of the anchorage of the zonule is variable. For the extraction of a morgagnian cataract a single delicate jerk is sufficient. This is because the zonular attachment is extremely weak, so much so that it is said to become dislocated by an angry look. On the other hand, in the case of disciform cataract, half a dozen or more delicate jerks are required, because the anchorage is very firm. However, it matters little whether one or two jerks or a dozen or more are used, so long as the jerks are nonviolent. Ultimately, the zonular attachment cannot but give way to the required extent at 6 o'clock. As these jerks are given in a direction away from the vitreous, there is no possibility of rupturing the hyaloid membrane or of expressing the vitreous. The direction of the application of the effort or power is just the opposite of that used in Smith's [3] pressure method. The nature of the effort is also different, and the scientific principle involved is fundamentally different. With Smith's pressure method the direction of the application of power for the extraction of a hard cataract is directly backward toward the optic nerve. For the extraction of a soft cataract, the application of power is downward toward the patient's feet. The pressure is continuous and intended to raise the tension of the vitreous gel, to deform the vitreous and thereby to rupture the zonule. On the other hand, with the lever action intracapsular method, irrespective of whether the cataract is soft or hard, the efforts made are jerky and superficial; neither continuous pressure nor deep, indeed, no pressure, is given. For both hard and soft cataracts, the efforts made are from behind forward in a direction away from the vitreous and from below upward, intended to hitch the lower border of the equator of the lens-in-capsule upward and forward away from its bed on the hyaloid fossa without disturbing the hyaloid membrane. The surgeon is therefore at liberty in extracting both hard and soft cataracts to repeat his delicate fish-angling jerks without hesitation and without fear of loss of vitreous until a small breach is made in the zonule at 6 o'clock. As no pressure or suction is applied either on the vitreous or on the lens-in-capsule, the question of expression or suction of the vitreous does not arise. The only thing required for the surgeon is a little patience for a few seconds until a breach is made in the zonule.

While nonviolence on the part of the surgeon need not be often hinted at and while the technic of the lever action intracapsular method is nonviolent in its very essence, still there is risk of violence from an unexpected quarter. This is from the patient. At any stage of the operation, from a trivial cause or from no cause, the patient may suddenly become impatient and nervous. He may squeeze the orbicularis muscle so violently that a considerable quantity of vitreous may be squeezed out. This violence by the patient is unintentional. It is no use remonstrating with him, as that makes him more nervous and more uncontrollable. As this sort of violence on the part of the patient at any stage of the operation is disastrous and as it will do no good to warn him beforehand against such sudden nervousness, one should take every precaution to control the orbicularis muscle and guard against its screwing up.

In preanesthetic days, control of the orbicularis muscle by a trained assistant was imperatively necessary for the success of the cataract operation. Nowadays, the eye speculum, the eyelid retractors, facial akinesia, retrobulbar anesthesia and external canthotomy have all contributed to keep the orbicularis muscle under control and to paralyze it.

In modern times, Smith,[3] after trying all the aforementioned methods and a few more, stated that it is not safe to dispense with the services of a competent assistant who is especially trained. With the lever action intracapsular method also the assistant should be competent enough to control the orbicularis muscle promptly by the use of the stirrup eyelid retractor (fig. 2) and also by his fingers on the superior orbicularis muscle in case of emergency if the patient suddenly squeezes the lids. At any rate, this sudden violence, which is disastrous, must always be guarded against.

STAGE II: ROTATION OF THE LENS-IN-CAPSULE

For the second stage of the operation the hyalonavicular fulcrum should be held between the thumb on one side of the handle and the other four fingers of the unused hand on the other side (fig. 1). The instrument should be applied horizontally and tangentially to the optic globe, as in the first stage. The navicular socket is to be kept fixed at 12 o'clock as before, socketing the upper border of the equator of the lens-in-capsule into its concavity, padded by the sclera.

The mango leaf dislocator should be held between the thumb on the side of the handle which is continuous with the concavity of the bend of the rod, or the petiole, and the index and middle fingers on the side of the handle which is continuous with the convexity of the bend of the rod, or the petiolar portion of the leaf (fig. 1). The instrument is to be held by the best hand of the surgeon, as before, and is to be

held perpendicularly to the optic globe with the concavity of the rod forward. The tip of the leaf should point upward. The tip of the dislocator and the adjoining portion of the leaf span should be insinuated into the breach in the zonule at 6 o'clock. Thus, the tip with the leaf span is slipped below and behind the lower border of the lens-in-capsule as a wedge, the cornea intervening. The lower or inferior border of the cataractous lens-in-capsule, rendered into a more or less rigid lever, is thus slowly tilted forward and upward away from its bed in the hyaloid fossa of the vitreous on the navicular fulcrum fixed to the upper or superior border of the equator of the lens-in-capsule, like the lid of a teapot or jug on its hinge. The slow tilting upward and forward movement of the lower border of the lens-in-capsule are effected by steady delicate effort of the leaf span from below upward and behind forward, away from the vitreous.[31] Only delicate efforts are required, because a lever of class II is formed in the mechanism of lever action. This is because the resistance of the zonular attachment is placed between the navicular fulcrum, socketing the upper 12 o'clock border of the more or less rigid cataractous lens-in-capsule and forming the rod of

Fig. 2.—Dutt's stirrup eyelid retractor.

the lever, and the effort applied to the diametrically opposite end of the cataractous lever by the leaf span of the mango leaf dislocator at 6 o'clock. A lever of class II always acts as a mechanical advantage, because in this case $\frac{\text{arm of effort}}{\text{arm of resistance}}$ is greater than unity. As more and more of the zonular attachment gives way during the upward and forward rotation of the lower border of the lens-in-capsule, more and more of it gives way from below upward, and thereby the point of resistance of the zonular attachment approaches nearer and nearer the fulcrum fixed at 12 o'clock. Or, in other words, as more and more of the zonular resistance is peeled off from below upward and the point of resistance approaches nearer and nearer the fulcrum, the denominator of the foregoing equation, viz., the arm of resistance, becomes lesser and lesser; while the numerator, viz., the arm of effort, i. e., the perpendicular distance from the point of application of the effort at 6 o'clock to the point of application of the navicular fulcrum at 12 o'clock, remains constant. Hence, the resulting mechanical advantage derived from lever action becomes greater and greater till the lower border of the equator of the lens-in-capsule has rotated on the navicular fulcrum at 12 o'clock for about 45 degrees. Thus, the mechanical advantage gained by lever action throughout the second stage of rotation of the

lens-in-capsule becomes progressively greater and greater. The second stage ends when the lower border of the lens-in-capsule has rotated clear out of the attached portion of the cornea.

It will be interesting and important to discuss the physical and anatomic relations between the vitreous and the lens-in-capsule and the possible disturbance of the vitreous owing to the dislocation and rotation of the lens-in-capsule and to the detachment of the zonule. The lens-in-capsule is nicely set in its bed in the hyaloid fossa of the vitreous, like a boat set in a muddy bank or dock anchored all round. The posterior surface with the posterior pole of the lens-in-capsule is just in apposition with the vitreous in the hyaloid fossa, which constitutes the hyaloid membrane. All round its equatorial border the lens-in-capsule is anchored by the zonule of Zinn in bundles of three rows. Thus, there exist all the physical conditions necessary for functioning of capillary attraction between the convex posterior surface of the lens-in-capsule and its concave bed in the hyaloid fossa. In order to avoid the powerful resistance of the capillary attraction, it is necessary either (1) that the lens-in-capsule be glided over the hyaloid fossa, as a boat set in a muddy bank or muddy dock is glided or (2) that a border of the lens-in-capsule be tactfully raised like the lid of a jug or teapot on its hinge by lever action, so as to admit atmospheric pressure between the hyaloid fossa and the posterior surface of the lens-in-capsule. In order that (1) a gliding movement of the lens-in-capsule may be possible, first, the whole of the zonular attachment must be detached previously; otherwise the lens-in-capsule cannot be glided out of its setting. Second, complete iridectomy should be performed previously so as to give clear passage to the lens-in-capsule. If iridectomy is not performed or only a buttonhole iridectomy is done, the foremost upper edge of the advancing lens-in-capsule is tucked into the upper angle of the posterior chamber and is netted by the attached iris. In order that (2) a lid on hinge lever action may be possible, it is not necessary to perform iridectomy. It is only necessary that a portion of the zonule attached to that border should be previously breached, so that there may be a passage for the atmospheric pressure to act between the posterior surface of the lens-in-capsule and the bed in the hyaloid fossa. It is therefore obvious that this second mechanism, i. e., the lid on hinge mechanism, is better than the first, i. e., the gliding-boat mechanism. The lid on hinge mechanism is exactly what is produced in the lever action intracapsular method.[31] A small breach is first made in the zonule at 6 o'clock by fish-angling jerks applied from the outside so as to admit atmospheric pressure through the breach. Then, the extreme lowest border of the equator of the lens-in-capsule at 6 o'clock is slowly and gradually raised like a lid on its hinge by lever action with the effort applied

from the leaf-span of the mango leaf dislocator on the navicular socket fulcrum. Thus, atmospheric pressure is admitted into and acts between the posterior surface behind the lowermost border of the lens-in-capsule and its corresponding bed in the hyaloid fossa. By this lid on its hinge mechanism, the capillary action and cohesion between the posterior surface of the lens-in-capsule and its bed in the hyaloid fossa are avoided. Moreover, as more and more of the posterior surface is raised from its bed on the hyaloid fossa from below upward, at the same time more and more of the zonular attachment is peeled off from below upward by one and the same lever action mechanism during rotation of the lens-in-capsule.

The illuminating notes in this connection and the diagrams given by Barraquer [26e] are worth noting: "There are those who believe that the posterior surface of the convex lens is in intimate contact with all points of its surface with the anterior surface of the vitreous from the identical concavity and the perfect juxtaposition of the two surfaces producing an adherence that renders it impossible to extract the lens by drawing it directly forward, as it would be impossible to separate the two surfaces thereby." The direct forward suction or traction and the impossibility of separating the two surfaces thereby are illustrated in figure 3 *A*. The possibility of success by gliding action in effecting upright delivery of the lens-in-capsule with upper edge foremost is illustrated in figure 3 *B* The arrows indicate the direction of the application of power.

Barraquer did not express his personal opinion about the necessity of avoiding capillary action and adherence of the posterior surface of the lens-in-capsule and its bed in the hyaloid fossa. But action is more eloquent than words, as the practical is more eloquent than the theoretic. What is done in Barraquer's suction method and also in the forceps traction methods to attain success?

Barraquer [26e] gave the following directions for effecting upright delivery of the lens-in-capsule with the upper edge foremost. "Once having caught hold of the crystalline lens by the force of the vacuum, and torn the fibres of the zonula, in order to withdraw the cataract from its position, if an iridectomy has been made it is sufficient to raise its superior border whilst it works upward, in such a way that the inferior border of the lens follows the curve of the patellar fossa, in contact with it, without exerting the least pressure or producing friction on its posterior surface." Thus, it is necessary that complete iridectomy be done and that the fibers of the zonule be completely detached in order to withdraw the cataract from its position by gliding over the curve of the patellar fossa in contact with it and to deliver the upper edge foremost.

Barraquer omitted to illustrate by diagram the mechanism of tumbling, though he called it "my usual method," nor did he explain how skilfully and scientifically capillary action is avoided thereby. Although delivery of the lens-in-capsule by tumbling is effected with Smith's pressure method as well as with the Knapp [11]-Török [17]-Elschnig [16] forceps traction with pressure, no one has so far explained the mechanism by which atmospheric pressure is admitted and capillary action avoided. How far the theory of "lid on its hinge" is applied in actual practice and also in "lid tumbling" will be considered.

In tumbling, which Barraquer [26e] called "my usual method," simple extraction with a peripheral buttonhole is made. The suction cup should hold the lens-in-capsule a little lower than the center of the pupil and behind the iris. Then the inferior border of the cataract is raised from its bed on the patellar fossa and its zonula is ruptured and tumbled

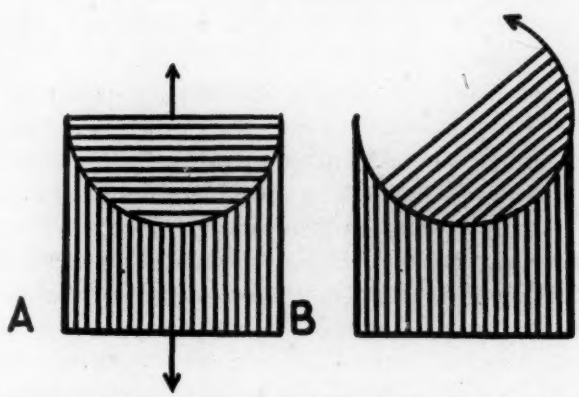

Fig. 3.—*A*, diagram illustrating direct forward traction or suction. *B*, diagram illustrating gliding boat. (Redrawn after Barraquer.[26e])

upside down, its inferior border thus rubbing the posterior surface of the iris. The delivery is effected with the lower edge foremost.

With the Knapp-Török-Elschnig [16] method, a small slit in the iris is made with de Wecker's scissors at about its root. Then the capsule is seized with the capsule forceps as low down as possible below the dilated pupil. Then the lens is gently rocked from side to side to breach the zonule. Thereafter, the lens-in-capsule is raised in the forceps, so that its lower edge is brought forward and upward through the pupil and delivered with the lower edge foremost, as in tumbling, the lens hook aiding the maneuver with pressure from the outside.

It is therefore clear that with Barraquer's [26] method a peripheral buttonhole is made in the iris, and with the Knapp-Török-Elschnig [16] method a slit is made near the root of the iris, but with neither is complete iridectomy done. A hold by the suction cup or by the capsule forceps is secured on the lens-in-capsule as low as possible. The zonular

attachment of the lower portion is then breached. The lower edge of the lens-in-capsule is raised either with the suction cup or with the capsule forceps from its bed on the hyaloid fossa and gradually tumbled. The zonular attachment, therefore, slowly gives way from below upward. Thus atmospheric pressure is brought into action, and capillary action and cohesion between the posterior surface of the lens-in-capsule and the hyaloid fossa cannot take place.

The lower the hold on the lens-in-capsule for the application of power to raise its lower border at 6 o'clock from the hyaloid fossa, the greater the advantage. With the lever action intracapsular method, the lowermost border of the lens-in-capsule is the strategic point on which the power or effort is applied from the outside. With neither the suction nor the traction method can the hold on the lens capsule for the application of power by the suction cup or the capsule forceps be made much lower than the lower border of the pupil because of the iris and because of the narrow nook of the posterior chamber below, where no instrument can reach.

The direction of the application of power by suction or by traction or by lever action is uniformly away from the vitreous and at the same time forward and upward, intended to raise the lower border of the lens-in-capsule from the hyaloid fossa of the vitreous and also to rotate it by tumbling or by turning on a navicular fulcrum. This mechanism is found practically convenient and successful in avoiding capillary action and cohesion between the posterior surface of the lens-in-capsule and its bed on the hyaloid fossa of the vitreous.

STAGE III: DETACHMENT OF THE ZONULE

When by rotation on the navicular fulcrum the lower border of the lens-in-capsule has rotated upward and forward away from its bed on the hyaloid fossa till it has cleared itself out of the attached lower half of the cornea, the stage III of detachment of the zonule begins.[32]

The hyalonavicular fulcrum is turned between the thumb and the fingers of the hand not used, in which it has been held throughout the operation, so as to bring the hyaloid socket fulcrum into action. The hyaloid fulcrum is placed horizontally and above the anterior surface of the lens-in-capsule engaging the convexity of the anterior pole of the lens-in-capsule in the concavity of the hyaloid fulcrum. The anterior pole and anterior surface of the encapsuled lens are now in direct contact and within the hyaloid socket fulcrum. The convexity of the anterior pole of the lens-in-capsule is thus securely socketed within the concavity of the hyaloid fulcrum, thereby forming a ball and socket joint fulcrum, and cannot slip. The mango leaf dislocator is now held horizontally and tangentially to the optic globe between the thumb and the index and middle fingers of the best hand of the surgeon. The

concavity of the bend of the petiolar portion of the rod of the mango leaf dislocator is placed in such a way that it hooks around the lower and posterior border of the encapsuled lens. As the lower border of the lens-in-capsule has now freed itself from the attached lower portion of the cornea, the concavity of the bend of the mango leaf dislocator is in direct contact with the posterior surface of the lower border of the encapsulated lens, nothing intervening.

By a delicate turning forward effort of the mango leaf dislocator, the lower border of the cataractous lens-in-capsule is made to turn forward and upward on the hyaloid socket fulcrum. Now that the points of resistance on both sides in the attachment of the zonule have approached much nearer to the fulcrum than before, the mechanical advantage gained by lever action has become much greater. Therefore, by a slow, steady and delicate turning effort with the advantage of lever action, the attachment of the remaining portion of the zonule of the lens-in-capsule is gradually detached completely from below upward without any appreciable resistance up to 12 o'clock. The encapsuled lens is held between the bend of the mango leaf dislocator and the hyaloid socket fulcrum. The encapsulated cataractous lens is nonviolently delivered by the temporal side of the incision.

COMMENT

The adaptation and application of the scientific principle of lever action to surgical instruments are not new or recent. Indeed, surgical scissors, elevators and forceps of various designs have been in use ever since the Susrutian age, 1,000 B. C. The ancients were enthusiastic about lever action and were aware of its unlimited potentiality. Archimedes (300 B. C.) once exclaimed: "Give me a fulcrum and I can rotate the earth!" Well, here is the hyalonavicular fulcrum. No wonder that a modern Archimedes can now rotate the most stubborn lens-in-capsule with perfect nonviolence.

A NEW METHOD FOR TRANSPLANTING PTERYGIUM

EDWIN M. NEHER, M.D.
SALT LAKE CITY

Ophthalmologists have recognized for many centuries that the only treatment for true pterygium is surgical intervention. Many and various operations have been devised for the removal of the pterygium, either some form of excision or transplantation in the lower cul-de-sac being used. These operations are well known to all ophthalmologists.

Transplantation of the entire pterygium beneath the upper bulbar conjunctiva has never been described. It has much merit and possesses advantages over all other operative methods.

OPERATIVE TECHNIC

After the usual surgical preparation of the conjunctival sac is carried out and local anesthesia is obtained, the lids are held apart with an eye speculum. The following steps are then performed:

The neck of the pterygium, including the margins, is grasped with a strong, narrow tissue forceps. While gentle traction is exerted upward with the forceps, a sharp von Graefe knife is used to dissect carefully and accurately the head and neck from the cornea and limbus, as in *A* of the illustration.

With the pterygium still held with the forceps, a pair of small curved scissors is used to make an incision approximately 1 cm. long, beginning at the upper end of the incision at the limbus and forming an angle of about 30 degrees with the upper margin of the pterygium, as in *B*. Then with the concave surface facing the eyeball, the closed scissors are inserted through the incision, and the blades are opened gently to free the pterygium and bulbar conjunctiva from the underlying sclera as far as the lower cul-de-sac.

The hold on the pterygium is released, and the upper conjunctival margin of the incision is picked up and the bulbar conjunctiva is freed from the sclera with a small strabismus hook, thus preparing a place into which the head of the pterygium is soon to be transplanted, as in *C*.

Each curved needle of a double-armed black silk suture is passed through the head of the pterygium from within outward, there being sufficient tissue between the two ends of the suture to make a firm and secure hold, as in *D*.

The speculum is removed, and the upper lid is retracted with a Desmarres lid retractor, as in *E*. With the eyes in their primary position, the head of the pterygium is grasped and used as a pattern, being placed on the upper bulbar conjunctiva in such a position as to cover the denuded area of the sclera completely and to make perfect coaptation of the normal conjunctiva at the limbus. The

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Read at the meeting of the American Ophthalmological Society, San Francisco, June 10, 1938.

position of the pterygium is mentally noted, or a better plan is to mark the location of the head on the conjunctiva with aniline stain.

The needles on the double-armed suture are carried through the incision and beneath the conjunctiva, and are brought out through the spot of aniline stain, as in *F;* tension on the suture slips the head into proper position, and tying the ends holds it there.

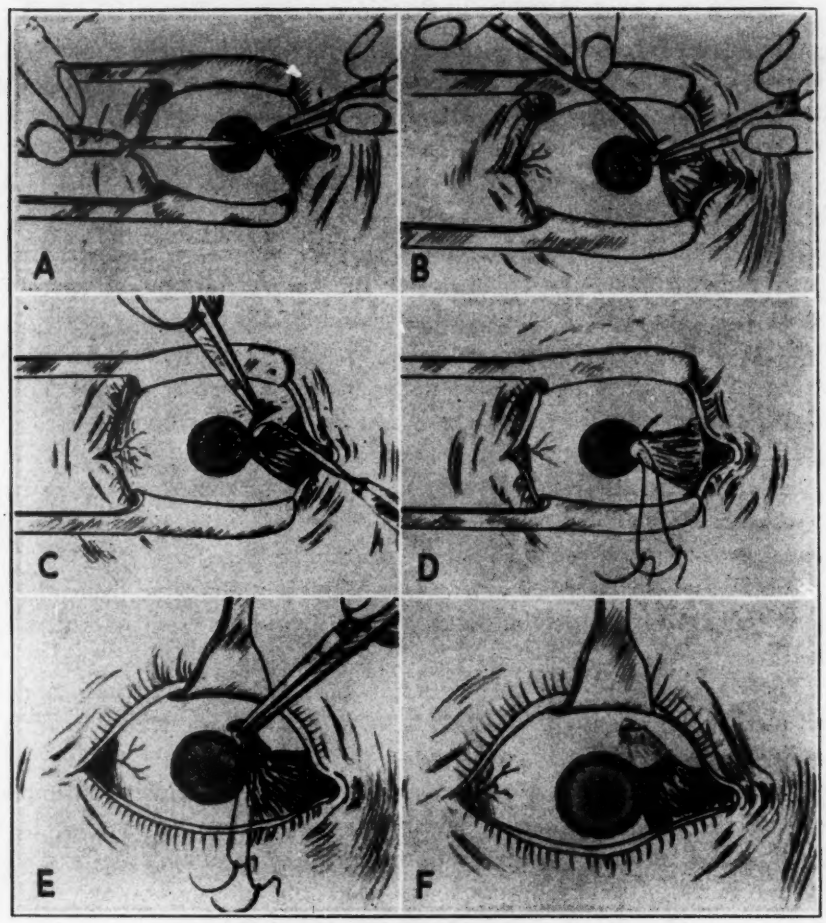

Fig. 1.—Technic of the operative procedure.

Thus the pterygium is transplanted beneath the upper bulbar conjunctiva, and the denuded area of the sclera at the former site of the pterygium is now completely covered with normal conjunctiva.

Atropine should be applied and both eyes should be bandaged for one day; the eye that was operated on should be bandaged for two or three days longer.

COMMENT

By removing the pterygium from the cornea, as depicted in *A* of the illustration, the operator can see the field of operation and control the depth of the dissection. Cutting the cornea deeper than necessary

is as bad as not completely removing all of the pterygium, since each delays the process of healing and encourages the formation of recurrent vascular tissue on the cornea.

It is important to make the incision in the bulbar conjunctiva before any attempt is made to free the pterygium and conjunctiva below from the underlying sclera, since this gives greater freedom for the manipulation and there is less likelihood of tearing the conjunctiva.

Should the pterygium be large, thick and fleshy or contain sclerotic areas, these should be dissected from the overlying conjunctiva. Their removal lessens the amount of congestion and shortens the period of healing.

A small strabismus hook or a spatula is useful to separate the upper bulbar conjunctiva from the underlying sclera.

The retraction of the upper lid with a Desmarres retractor permits a better view to place the "pattern" on the bulbar conjunctiva correctly. It also provides greater space to insert and tie the sutures.

It is not necessary to place the head of the pterygium as far as the bottom of the upper cul-de-sac; it should be carried only far enough beneath the bulbar conjunctiva to make accurate juxtaposition of the normal conjunctiva at the limbus, without undue tension of the tissues.

If both eyes are rather firmly bandaged for one day, the normal conjunctiva will adhere to the denuded sclera in the proper position. The sutures may be removed on the third day.

While the advantages of transplanting the pterygium beneath the upper bulbar conjunctiva are many and obvious, a few of them are noted:

The site of the former pterygium is completely covered with normal conjunctiva the fibers of which take a vertical position at the limbus, making the return of the pterygium unlikely.

There is no break in the continuity of the normal conjunctiva covering the denuded sclera; hence, less probability of congestion or infection and return of vascular tissue on the cornea.

The incision in the conjunctiva and the pterygium are hidden beneath the upper lid, thus shortening the period of disability.

The normal pressure of the upper lid against the eyeball holds the tissue in position and protects the normal healing of the wound from irritation and disturbance.

The upper bulbar conjunctiva is constantly washed by sterile tears, which together with its upper location, minimizes the chances of infection.

The operation is easily performed, the accurate covering of the denuded sclera can be definitely planned and executed, and the final result is equally satisfactory to the surgeon and the patient.

Suite 1120 Boston Building.

DISCUSSION

DR. FRANK E. BURCH, St. Paul: For the reasons given by Dr. Neher I have been transplanting pterygium by this method for the last twenty-five years. I believe that many use this technic as being more logical than the one usually recommended by McReynolds.

DR. CONRAD BERENS, New York: If I understand Dr. Neher's technic, I have used a method similar to this procedure of transplanting pterygium upward (fig. 2). In 2 cases, the cornea was again invaded. In 1 case the invasion occurred after three years and in the other after eight years. Recently I have drawn the conjunctiva together between the pterygium and the cornea and turned the pterygium more sharply upward.

DR. E. C. ELLETT, Memphis, Tenn.: I prefer to remove the head of the pterygium by evulsion with a flat, blunt hook. If a knife is used for the purpose, it may go either too deep or not deep enough. In order to have a raw surface of the pterygium to apply to the raw surface of the conjunctiva, I scarify the upper surface of the pterygium

Fig. 2.—Transplant of pterygium upward (modification of Miller's technic of Desmarres' operation).

with a serrated chalazion curet. The suture is placed through the head of the pterygium and through the conjunctiva close to the cornea, in order to obviate leaving a small raw area along the edge of the cornea, which is a favorable site for the development of granulation tissue. When the suture is brought out through the conjunctiva it is threaded through two openings in a small silver suture plate; this avoids puckering up the tissues and keeps them spread out flat.

DR. EDWARD JACKSON, Denver: I have not tried Dr. Neher's method, but it seems to fulfil the indications for a successful operation better than any procedure I have tried. I learned a good many years ago that success apparently depends almost entirely on getting a close union at the corneal margin between the conjunctiva and the underlying tissues. This method of Dr. Neher, by which one would have a relatively thin edge of pterygium where it was drawn under the conjunctiva, and his incision, starting at the limbus, where the conjunctiva and the sclera are closely united normally, and running up and allowing room for the whole pterygium to be slipped under it, certainly

would afford an immediate, quick and close union of the conjunctival covering of the pterygium where it is drawn into the slit. Bringing the pterygium underneath the conjunctiva in that way would avoid the difficulty to which Dr. Berens alluded, which necessitated repetition of the operation.

DR. EDWIN M. NEHER, Salt Lake City: I have searched the literature as thoroughly as I could but have found no description of this operation. Until such a description can be found, I assume that the operation can be considered as new.

As Dr. Jackson especially pointed out, the important thing is to have the conjunctiva joining on the limbus, not overlapping, but in accurate position to the limbus, with the fibers in the vertical position.

SOME PHYSIOLOGIC AND PHARMACOLOGIC REACTIONS OF ISOLATED IRIS MUSCLES

PARKER HEATH, M.D.
AND
C. W. GEITER, M.D.
DETROIT

This paper is a preliminary report of an experimental study of some reactions of isolated iris muscles, a new autographic method being used. Both physiologic and pharmacologic stimulators and depressors were employed. The delicate method showed physiologic tissue response and permitted pharmacologic instead of toxic reactions.

METHOD AND APPARATUS

The sections of iris were taken from the enucleated eyes of anesthetized or of stunned animals, mounted with clips and at once suspended in oxygenated Ringer's solution. The temperature was controlled (from 32.7 to 33.2 C.) and also the p_H (from 7.5 to 7.7, LaMotte colorimetric method). The suspension was fixed below and was attached above by a delicate thread to a galvanometer at a controllable tension. To increase the load of work, the muscles contracted against the elasticity of delicate coiled springs, and conversely a return to a relaxed state was favored by the stored energy in the springs. The load of work on each preparation was small. The average weight of an immersed suspension of clips and sphincter was 0.0507 Gm. The weight of the suspension and clips in the air was 0.0759 Gm. Muscle fibers of the suspension were comparatively parallel, an ideal physiologic preparation. The sections were started by incision with a cataract knife through the iris and were completed with iris scissors. The clips were curved to conform to the curve of the iris. Mechanical deflections of the galvanometer indicator, due to contraction and relaxation of the muscles, produced in a constant electromagnetic field differences in potential. These differences in electric current thus formed were conducted through amplifying tubes and rectifier to a string galvanometer. By deflection of a mirror on the string (as in electrocardiograph) a light beam recorded changes on a sensitized bromide paper. Time was electrically recorded. This arrangement, the electromyograph, was extremely sensitive to change in muscle tension, and did not cause undue work. By amplifications, minute changes could be recorded on the myogram. Also slight variations were recorded due to the time rate of the myograms—five seconds time made 3/8 inch (0.9) of record. Improved technic in removing the sectors has cut down the need for amplification except for recording minute changes. It now takes from three to five minutes to remove and mount the sections.

From the Ophthalmology Department of Wayne University and the Research Laboratory of Frederick Stearns & Co.

PHYSIOLOGIC RESPONSE AND SPONTANEOUS MOVEMENTS

Freeing the sphincter or dilator under Ringer's solution from its antagonist in the animal led to a contraction of the fibers. The suspended sphincter characteristically showed in outline the figure 8, and the dilator contracted markedly. This may have been due to the mechanical stimulation of cutting and mounting and probably was not due to freedom from tension of the opposing muscle. After from ten to twenty minutes in a bath of Ringer's solution, the preparation relaxed from the mechanical stimulation. A fresh preparation suspended with minimal tension showed a varying and uneven tonus. With minimal stimulation and a light work load, both dilator and sphincter showed an

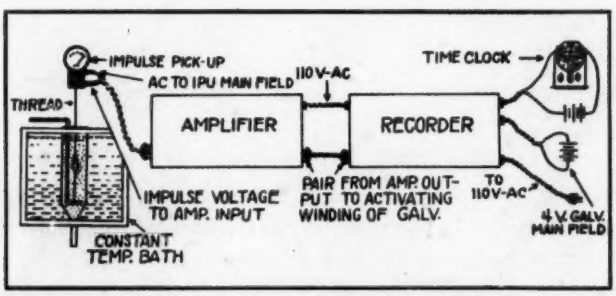

Fig. 1.—Outline of apparatus arrangement, showing the suspension in the bath, the impulse pick-up, the amplifier and rectifier and the recording apparatus, consisting of a galvanometer, mirror, light beam, timer and sensitized paper.

Fig. 2.—Rabbit dilator, fresh preparation; slight tension and amplification; irregular rhythm, from fifteen to twenty seconds. More tension would increase the response and lengthen the intervals; more amplification would show secondary curves.

irregular contracting and relaxing action (fig. 2). With heavy work and overload, the responses were gradual and the curves free from steps, the top showing a tetanic contraction. The curve of spontaneous contraction is made up of several parts: (1) an irregular steplike contraction phase, (2) a short plateau and (3) irregular relaxation phase with a decline to a no tension position and then a repeat to a lower rise, each rise and fall being associated with much variation. Some preparations showed rhythmic contraction, especially with the steadying effect of a light load, the time interval being about from twenty to sixty seconds. Our impressions were that the fibers of the iris muscle con-

tracted with some disassociation and asynergia. The maximum contraction or summation effect showed this. In other words, the peak responses were uneven and not level. The fatigability interval was short. After prolonged rest (about one hour), practically equal responses resulted from the same stimulus. A rebound from sudden changes in load increased the contraction responses (fig. 3). The total workability of the dilator sectors, contrary to usual reports, seemed to exceed that of the sphincter ring. In this we agree with Magitot.[1] We also agree with ten Cate,[2] who employed the Wessely[3] suspension method and recorded photographs of iris sectors, that there are spontaneous movements. But our sensitive methods in the rabbit suggested an irregular rhythm. Solely after noting the fatigability and relative strength of suspensions of isolated dilator and sphincter in vitro, we gained the impression that in vivo there cannot be actual antagonism between the two muscles any more than there is an active

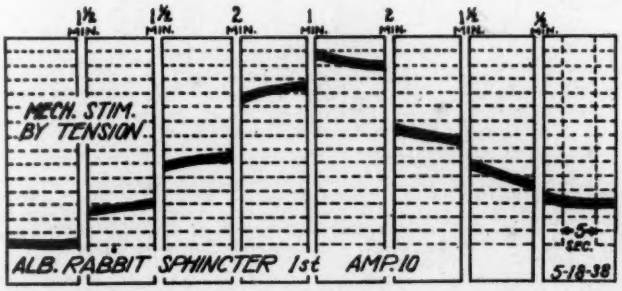

Fig. 3.—Albino rabbit sphincter; enucleated eye slightly sensitized in iced Ringer's solution for three hours; amplification, 10. The muscle was stimulated seven times by an increase of tension or work, the curve continually rising after such stimulus.

antagonism between the internal and the external rectus muscle. The notion that the sphincter is active and the dilator passive seems fallacious; also that the dilator acts by "blockade" and is not able to relax actively, except through the ability of a gliding blockade. In our opinion the dilator does not maintain a continuous tension, contrary to Poos.[4] Our suggestion is that there is a perfect cooperation between the sphincter and the dilator. The contraction of one is associated with the relaxation of the other. Both physiologic and pharmacologic response of sectors of isolated iris muscle were markedly

1. Magitot, A.: L'iris, étude physiologique sur la pupille et ses centres moteurs, Paris, Gaston Doin, 1921.
2. ten Cate, J.: Arch. néerl. de physiol. **6**:258, 1921-1922.
3. Wessely: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. **42**:26, 1920.
4. Poos, F.: Arch. f. exper. Path. u. Pharmakol. **126**:307, 1927.

reduced in the presence of free blood. The older the stored preparation, the more sensitive, quicker and shorter the response. The response of iris muscles from eyes of old animals was low. Previous inflammatory disease of the iris, such as iritis, also sharply reduced the reactions. Pigmented and unpigmented irides responded equally. The muscles were sensitive to oxygen supply; increased reaction and rhythm followed the plus supply and decreased the minus supply. Lowering the temperature of the bath caused contraction, and rising temperatures caused relaxation. We worked in a fairly narrow temperature range (about 0.5 C.). The latent period responses of the smooth iris muscle of the rabbit were like those of other smooth muscles, estimated from one half to two seconds. This time variability seemed to be due to the effect of dilution. The pharmacologic responses to stimulators showed an interesting short, active depression phase before stimulation

*Ion Reactions According to Poos**

Chemical Agent	Sphincter	Dilator	Comment
Potassium	Stimulator	Depressor	Increase tonus and spontaneous rhythm
Barium	Stimulator	Depressor	Strongest stimulator
Strontium	Stimulator	Depressor	Strong effect
Calcium	Depressor	Stimulator	
Magnesium	Depressor	Stimulator	Similar to epinephrine

* Poos worked out the effect of potassium, magnesium, calcium, strontium and barium ions, using neutral chloride salts in hundredth molar solution. With Ringer's solution isotonicity maintained by reducing the sodium chloride; the corresponding quantities of sodium chloride were determined after considering water of crystallization by interpolation from the depression of the freezing point. The solution contained, besides the salts to be examined, the correspondingly reduced quantity of sodium chloride and the other salts in Ringer's solution. No bicarbonate was added to the solutions of strontium and barium. Poos found that the deviation from normal Ringer's solution (p_H 7.5) was too small to be considered a source of error (p_H from 7.3 to 7.6).

began. The rabbit sphincter and dilator, like other smooth muscles, are sensitive to acid and alkali changes. An increase of hydrogen ion causes a decrease of tonus, and a decrease raises the level of tonus. We worked in a range of p_H from 7.5 to 7.7. Stimulators for both sphincter and dilator are cold, mechanical agents, electric current, oxygen plus and alkalization. Depressors for both sphincter and dilator, and especially the sphincter, are oxygen minus, heat, acidification, free blood, aged tissue, iritis aftermath, overwork, fatigue and trauma.

SOME PHARMACOLOGIC REACTIONS

The work begun by Loewi on the transference of nerve impulses to the cell by acetylcholine opened a new field in autonomic neurology and its pharmacology. This humoral or chemical mediation hypothesis is well, but not completely, developed. It seems that bound acetylcholine exists, that it may be produced by the preganglionic nerve endings (Feldberg and Vartiainen [5]), that it acts on the cell and that a choline

5. Feldberg, W., and Vartiainen, A.: J. Physiol. **83**:103, 1934.

esterase of unknown origin found in fluids of the body or cells may block the activity of the acetylcholine by hydrolizing it, thus regulating the effect of the acetylcholine. It also seems that an epinephrine-like substance is produced in the sympathetic nervous system and stimulates it at the junction of the sympathetic neuron and the cell (Cannon). The reaction of the active choline-like compound with the cell is ionic or saltlike; the cation replaces sodium, potassium or calcium ions of the cell. The combination of the cation and the cell changes the physicochemical activity of the cell. Atropine and pilocarpine offer different chemical structures. The antagonism between atropine and acetylcholine suggests different cell receptors or chemical antagonisms due to affinity between atropine and esterase of acetylcholine. An excess of potassium set free by cell activity might liberate acetylcholine. The ophthalmologist may be led into most interesting and important speculative fields by following the literature of this subject.[6]

The somewhat disassociated contraction of isolated dilator and sphincter fibers suggests a high summation. That is, to activate the muscle fibers a single nerve impulse would require an intermediate substance of the cholinergic or adrenergic type. The quick drop of response to atropine or acetylcholine by suspended muscle after changing the bath to fresh Ringer's solution indicates that the effect of these substances requires their continued presence about the muscle fibers and that they are not stored within the cells. Velhagen[7] has shown an active acetylcholine-like substance in aqueous, uvea and retina. He showed an active effect of this substance on the iris sphincter and an overactive atropine effect. The double innervation of sphincter has been suggested from several angles. Poos supported this idea from his valuable work on isolated iris and sphincter. Many authors have studied the effect of epinephrine on smooth muscles to the end of supporting the theory of double innervation. Joseph[8] demonstrated in living animals a relaxation of the sphincter on stimulation of the cervical portion of the sympathetic trunk. Our studies confirmed this from the in vitro angle.

We also demonstrated an indirect atropine effect on the dilator segment which was contracted by epinephrine. That is, the muscle plus

6. Gaddum, J. H.: Gefässerweiternde Stoffe der Gewebe, Leipzig, Georg Thieme, 1936. Henderson, V. E., and Roepke, M. H.: Physiol. Rev. **17**:373, 1937. Brown, G. L.: ibid. **17**:485, 1937. Rosenblueth, A.: ibid. **17**:514, 1937. Eccles, J. C.: ibid. **17**:538, 1937. Alles, G. A.: Physiol. Rev. **14**:276, 1934. Loewi, O.: Arch. f. d. ges. Physiol. **193**:201, 1921; **204**:361, 1924. Poos, F.: Klin. Monatsbl. f. Augenh. (supp.) **78**:227, 1927.

7. Velhagen, K., Jr.: Arch. f. Augenh. **105**:573, 1932; **108**:126, 1933; **109**:195, 1935.

8. Joseph, D. R.: Am. J. Physiol. **55**:279, 1921.

epinephrine or neo-synephrin hydrochloride equals contraction (fig. 4). The muscle plus epinephrine, or neo-synephrin plus atropine equals *active* relaxation (figs. 5 and 6). The relaxed muscle plus atropine equals no change. Thus atropine either prevents the continual attachment of the sympatheticomimetic substance to the cell or its reaction from the attachment attained. This is assuming that the atropine has no effect on the dilator alone. It has been pointed out that in some vascular areas stimulation of the sympathetic system causes vasodilation due to the production of acetylcholine and that atropine removes

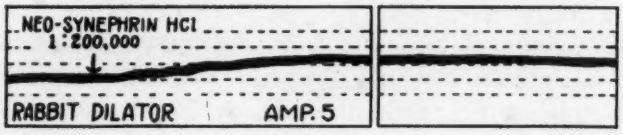

Fig. 4.—Rabbit dilator; neo-synephrin hydrochloride, 1:200,000; amplification, 5. The return to the base line may take as long as twenty minutes.

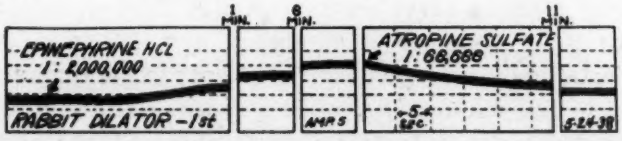

Fig. 5.—Rabbit dilator, fresh preparation; amplification, 5; epinephrine hydrochloride, 1:2,000,000; six minute interval; atropine sulfate, 1:66,666. A quick drop in the curve followed the administration of the atropine, indicating active antagonism.

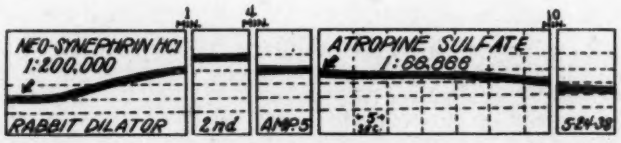

Fig. 6.—Rabbit dilator, second run (same preparation as in figure 5); amplification, 5; neo-synephrin hydrochloride, 1:200,000; four minute interval; atropine sulfate, 1:66,666. The atropine showed an active antagonism to the neo-synephrin hydrochloride.

this effect (Dale [9]). The depressing effect of atropine on the dilators of rabbits contracted by epinephrine, neo-synephrin or benzedrine was definite and antisynergistic. Preparations of isolated sphincter of the rabbit were examined for synergy. Subreactive dosages of homatropine hydrobromide, epinephrine, neo-synephrin or benzedrine were established. Then after contraction by acetylcholine these doses were introduced separately and successively and the effects noted on the curves at different points. A fresh sphincter will remain well con-

9. Dale, H. H.: J. Pharmacol. & Exper. Therap. **6**:147, 1914.

tracted and maintain a high rise in curve as long as fifteen minutes in a bath of acetylcholine in a dilution of 1:66,666. The joint use of homatropine and epinephrine or of homatropine and neo-synephrin, each in subeffective doses, applied at the beginnings of the peak of the acetylcholine response will depress such a fresh sphincter (fig. 7). But the response is not marked, and the curve maintains a gradual fall after a short initial drop. The length of time required for the curve to return to the base line is nearly equal to that after the administration of acetylcholine alone. We have more comparative studies in progress.

SOME CLINICAL SPECULATIONS

From the effect of heat on isolated iris muscle, its therapeutic value from prolonged use would be questionable. An active carrying in and out of blood and of antibodies in infection probably would be of value. But prolonged heat induces passive congestion and slows up local activity. If heat lowers the sphincter effect more than the dilator, some

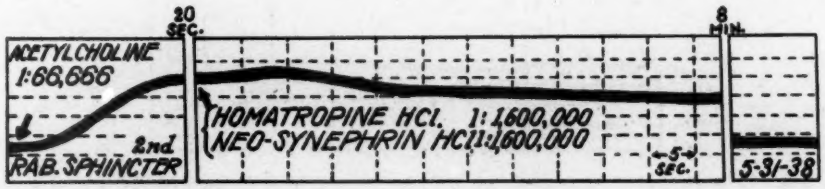

Fig. 7.—Rabbit sphincter, second run. A rise in the curve followed the use of acetylcholine, 1:66,666; hematropine hydrobromide plus neo-synephrin hydrochloride, each in a dilution of 1:1,600,000, caused a slight dip in the curve, followed by a slow return to the base line.

dilatation would follow its use. This would soon be offset by the larger area of congestion occupied by dilator sectors. Relief from the passive congestion could be partly and early had from cold. But the prolonged use of cold would again slow down the passage of fluid through the tissues. The letting of venous blood and the use of a strong decongestive drug, such as epinephrine or neo-synephrin, would be of more value. Blood in the anterior chamber in or behind the stroma of the iris may explain uneven and reluctant dilatation. When much blood is present in the anterior chamber and is of the dark, or tar, variety, a conservative measure is to evacuate it through incision, unless the opposite effect of immobilization is desired. The tearing of synechia by atropine is difficult to explain if this drug only relaxes the sphincter. The dilator fibers have substantial power for work, and it is possible that the formation of adhesions mechanically stimulates these fibers. A quicker, fuller dilatation and of shorter duration is had from a sympathetic dilator stimulus alone. Dilator stimulus plus atropine gives after a maximum response a drop back into a plateau. This drop is unlike the response from the sympathetic stimulator alone. One of the

most even ways to apply a drug, especially a sympathetic stimulator, is by an emulsion. Many of the variable effects obtained by some in clinical experimentation have been due to the winking out of the drops. Oil in water emulsion gives a fairly prolonged, even application to the cornea, through which the drug must be absorbed. Drugs that are strong sympathetic stimulators may be used in the field of ophthalmology, since the eyes are relatively resistant to them. To determine systemic reaction (rise in blood pressure) of an emulsion of 10 per cent neo-synephrin hydrochloride applied to the conjunctival sac or injected intravenously, an experiment on a dog was done. This showed little systemic effects with a 10 per cent emulsion (1 drop being equivalent to approximately 30 mg.) in the conjunctival sac as compared with the drastic effect of intravenous injection (fig. 8).[10]

Fig. 8.—Comparative blood pressure effects in a dog to neo-synephrin hydrochloride administered into the cornea and intravenously. No significant rise followed a single application to the cornea, but a slight rise occurred after three doses. A single drop of a 10 per cent solution (about 30 mg.) administered intravenously caused a rise too high to record.

10. In this experiment a female dog weighing 6.5 Kg. was used. The anesthesia consisted of sodium barbital, 0.25 Gm. per kilogram of body weight; chlorobutanol, 0.1 Gm. per kilogram interperitoneally, and atropine sulfate, 0.05 mg. per kilogram hypodermically. The carotid artery was exposed and attached to a mercury manometer in the usual way, and recordings were made on a slowly revolving kymograph. The intravenous injection was made by way of the femoral vein. The results are shown in figure 8. 1. A normal blood pressure tracing is shown first. One drop of the emulsion (from the regular tube) was dropped on the upper part of the cornea, care being taken not to bring any pressure on the eyeball to avoid any vague stimulation. Little effect was noted. The sac was irrigated with Ringer's solution until the washings showed no trace of the emulsion. 2. After a fifteen minute rest, 2 drops of the emulsion was applied to the sac, causing a gradual rise within one minute. The maximum rise was approximately 6 mm. of mercury. This elevation was sustained after two ten minute rest periods (of the kymograph). The sac was then irrigated with Ringer's solution until the washings showed no trace of the emulsion. 3. After a forty minute rest, 1 drop of the emulsion dissolved in 0.6 cc. of Ringer's solution was injected into the femoral vein, causing an immediate rise of over 120 mm. of mercury (too high to record). The original blood pressure at the start of the experiment was 124 mm.

The sensitizing effect of one substance on another is of use in refraction, for which a quick, sharp response is wanted followed by a quick subsidence. The relative effect of neo-synephrin hydrochloride and benzedrine sulfate, each in a dilution of 1 : 50,000, on the acetylcholine-contracted sphincter of the rabbit may be seen in figures 9 and 10. The neo-synephrin produced considerably more depression of the sphincter. The effects of synergism of drugs may be due to double innervation; that is, with smooth muscles a stimulus may also cause a relaxation of an opposing muscle. Also, this effect may follow anatomic arrangement of the muscle fibers. The synergistic response to drugs may be due to the addible effect and also to sensitization, so that one

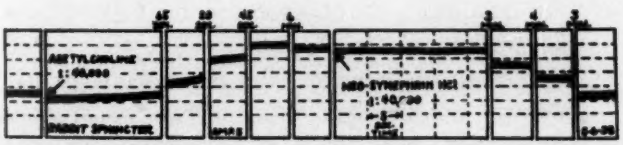

Fig. 9.—Rabbit sphincter; amplification, 5; acetylcholine, 1 : 40,000; neo-synephrin hydrochloride, 1 : 40,000. A rise in the curve occurred after the administration of the first drug and a fall to the base line after the administration of the latter.

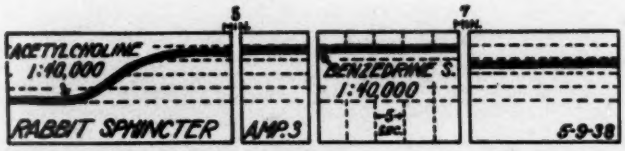

Fig. 10.—Rabbit sphincter; amplification, 3; acetylcholine hydrochloride, 1 : 40,000; benzedrine sulfate, 1 : 40,000. A rise in the curve occurred after the use of the acetylcholine, and the benzedrine sulfate failed to depress it to the base line.

drug increases tissue sensitivity to another. Removal of active inhibitors serves the same purpose. These possibilities are of practical value in therapeutics.

CONCLUSION

Isolated iris muscles, mostly of the rabbit, were investigated by a new autographic method. This method is extremely sensitive to physiologic and pharmacologic stimuli. An irregular spontaneous rhythm was found in the relaxed muscle. More rhythm was produced by a weakly loaded muscle. Mechanical stimuli produced contraction. The smooth iris muscles have qualities in general like those of other smooth muscles. The conclusions were reached that the sphincter and dilator do not oppose one another's action but cooperate. The impression was further gained that the total work power of the dilators was greater than that

of the sphincters. As far as our experiments went, the ion reactions as found by Poos were duplicated. A group of substances which stimulate the parasympathetic system, such as acetylcholine, mecholyl, physostigmine and pilocarpine, stimulated the sphincter but had no reaction on the relaxed dilator. A group of stimulators which affect the sympathetic nervous system, such as epinephrine, cocaine, ephedrine, neosynephrin, benzedrine and paredrine (β-4-hydroxyphenylisopropylamine), were noted to stimulate the dilator fibers. Atropine and its group relaxed the sphincter and also relaxed the dilator when it was in a state of contraction due to epinephrine or neo-synephrin or benzedrine. A slight synergistic effect was found from sphincters contracted by acetylcholine, subminimal doses being used in combination, homatropine with either neo-synephrin or epinephrine or benzedrine. This was slight and rather variable. The total time depression effect on the contracted sphincter was questionable. An increase of tonus was accomplished by cooling, alkalization and mechanical stimulation and a decrease by acidification, heat, previous disease and age of tissue. The iris muscles could be sensitized by removal from the eye and kept in a cool state from four to thirty-six hours. No effects on the isolated iris muscles of the rabbit were found with insulin.

Miles Bruno, M.S., assisted with the experimental work.

CONGENITAL CYST OF THE VITREOUS

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SOUTH BEND, IND.

A review of the ophthalmic literature shows that congenital cyst of the vitreous is rare. Tansley [1] in 1899 described a cyst in the center of the vitreous chamber as follows:

> It would settle toward the disc or lens according to gravity following movement of the eye. It was irregularly spherical with small indentations, somewhat resembling a potato, and this simile was made still more positive by there being spots and lines of pigment upon the capsule. The spheroid was itself transparent or nearly so, and could only be seen by its pigment and capsule outline. The presence of the pigment upon its capsule would indicate that at some time there had been imflammatory action.

In a discussion of this cyst Dr. Alt offered the following explanation for its origin, which since then has been largely accepted:

> This is very interesting and in thinking of what might possibly give rise to such a cyst in the vitreous body, it occurs to me that perhaps a tumor that I have now found in eight eyes affecting one ciliary process only and looking like an adenoma undergoing mucoid degeneration and which I have described as adenoma of the ciliary process might give rise to such a cyst.

Dr. Randall offered at this time the explanation that cystic growths may be attached at the site of a coloboma. He considered this cyst one of "that character, formed at the point of a coloboma, loosened from its attachment and set adrift by a process of closure of the congenital cleft. It could be a vacuoled vitreous exudate."

Troncoso [2] in 1903 described a pigmented, transparent cyst of the vitreous which moved about in the vitreous, returning to the same place. His explanation was that it was a degenerated ciliary process, filled with aqueous humor, which had broken loose.

Shine [3] in 1913 presented a woman with a cyst of the vitreous before the ophthalmologic section of the New York Academy of Medicine. His description follows:

> The cyst was of steel gray color, floated freely about on movement of the eyeball, but on cessation of movement always seemed to return to the same point just behind the ciliary body, below or slightly to the temporal side.

1. Tansley, J. O.: Tr. Am. Ophth. Soc. **9**:507, 1899.
2. Troncoso, U.: Ann. d'ocul. **30**:341, 1903.
3. Shine, F. W.: Arch. Ophth. **42**:398, 1913.

His explanation of its origin was that it was composed of epithelial tissue, an outgrowth of the ciliary body, detached or still attached to it by an invisible filament. Dr. Friedenberg had seen a similar case. The cyst was slightly pigmented and had a slow motion.

Scarlett [4] in 1929 described an oval translucent cyst one and one-half times the size of the disk in the anterior temporal quadrant of the vitreous. It consisted of two parts, joined by a constriction which gave the appearance of a cap. Sprinkled over the surface of the cyst were numerous black dots the size of a pinpoint. The cyst was freely movable in a fluid vitreous.

Hurwitz [5] in 1933 presented a girl with a cyst floating free in the vitreous before the Baltimore City Medical Society. The cyst was heavier than the vitreous, and when the patient held her face down the cyst would almost come up against the lens. It had many irregular spots of pigment on its surface. Hurwitz was fortunate in being able to see the cyst with the slit lamp. He stated:

> It appeared as a silver-white glistening sphere pigmented below with a shred or two of connective tissue running off loosely from its upper portion. My own feeling is that the cyst originated congenitally in a ciliary process and became detached into the vitreous.

Meding [6] in 1933 described a congenital cyst of the vitreous as follows:

> ". . . a round lens shaped body immediately posterior to the lens floating across the enlarged pupil and sinking slowly out of sight. Except for smudges of dark brown around its edges, the body was translucent and behaved very much like a dislocated lens. The slit lamp directed tangentially illumined the body beautifully, giving it the appearance of a gilded ball but afforded no penetration. Examined with the retinoscope the brown smudge proved to be granular deposits of pigment on the surface. The cyst moved up and down and remained in the line of vision more constantly in the morning. It was confined in its movement to a pathway or to a circumscribed shallow area. The circumscribed area in which it moved suggested that this body had existed from birth and was as transparent as the vitreous up to the date of its interference with vision; or it may have escaped or broken some attachments at that time.

He thought that if the cyst were of hyaloid origin there should have been some signs in the lens or elsewhere.

Seech [7] in 1933 presented a patient with a cyst of the vitreous before the Los Angeles Society of Ophthalmology and Otolaryngology. It

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4. Scarlett, H. W.: Tr. Am. Ophth. Soc. **27**:154, 1929.

5. Hurwitz, C. E.: Cyst in the Vitreous: Report of a Case, Arch. Ophth. **9**:825 (May) 1933.

6. Meding, C. B.: Free Cyst Floating in the Vitreous, Arch. Ophth. **11**:973 (June) 1934.

7. Seech, S. G.: Congenital Cyst in the Vitreous, Arch. Ophth. **11**:947 (June) 1934.

Fig. 1.—Congenital free floating cyst in the vitreous. The fundus is seen indistinctly, as the cyst is in focus with the ophthalmoscope. The shiny hyaline appearance is best seen over the edge of the pupil, below. Similar lines appear dark above as a silhouette against the background. The prepapillary membrane is at the lower nasal side of the disk.

was a slightly oval cyst in the lower half of the vitreous, divided into two parts by a constriction. According to Seech:

> The cyst showed considerable black pigment in several places apparently on its inner surface. There were numerous dots of pigment scattered around in this part of the vitreous and the fibrils of the anterior part of the vitreous were absent.

McLean,[8] Brewerton,[9] Koller,[10] Hill,[11] Lacarrere,[12] Litinsky,[13] Perara [14] and Vennin [15] described cysts of the vitreous occurring in eyes with retinitis pigmentosa or other degenerative or inflammatory diseases of the fundus, and although they may have been congenital, they were not of necessity such. Frequently degenerative or inflammatory changes produce such a cyst. Litinsky, McLean, Vennin and Perara, however, in my opinion gave a better explanation of the origin of these congenital cysts than most observers. They were of the opinion that the cysts originated from the fetal ocular cleft or the mesodermal elements of the embryonic vitreous or hyaloid apparatus.

Other observers have reported cysts attached at or near the optic papilla but not floating free in the vitreous. Such cysts probably are more closely related to the cysts floating free in the vitreous than are cystic degenerations of the ciliary processes, which have been so often accepted as the site of congenital free floating cysts in the vitreous.

Koller [10] in 1901 described a cyst of the vitreous as follows:

> The lower one-third of the disc appears to be hidden by a dazzling-white, egg-shaped body. Extending from this body were two short and one long process. The long process extended forward as a hyaloid artery and ended blindly near the nasal lower quadrant of the lens. There was a history of trauma in childhood.

He explained this cyst as evidently a widening of the hyaloid artery and its sheath at its posterior extremity, where it emerges from the optic nerve.

Schwartz [16] in 1936 presented a patient with a cyst of the vitreous attached to the retina before the Clinical Society of the Harlem Eye and Ear Hospital. Directly below the papilla there was a more or less

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8. McLean, A. L.: Am. J. Ophth. **16**:51, 1933.
9. Brewerton, E. W.: Tr. Ophth. Soc. U. Kingdom **33**:93, 1913.
10. Koller, C.: Tr. Am. Ophth. Soc. **9**:380, 1901.
11. Hill, E., in discussion on Scarlett.[4]
12. Lacarrere, J. L.: Nota sobre un caso de formaciones quisticas hialoides, inflammatorias? simetricas prepapilares, in Concilium ophthalmologicum, 's Gravenhage (The Hague), Netherlands, 1929.
13. Litinsky, G. A.: Klin. Monatsbl. f. Augenh. **87**:205, 1931.
14. Perara, C. A.: Bilateral Cyst of the Vitreous, Arch. Ophth. **16**:1015 (Dec.) 1936.
15. Vennin: Lyon méd. **119**:974, 1910.
16. Schwartz, L. H.: Cyst of the Vitreous Attached to the Retina, Arch. Ophth. **16**:230 (Aug.) 1936.

transparent bluish white swelling about two times the size of the disk. The cyst was adherent to the retina and to the central retinal vessels. The surface of the cyst was slightly pitted.

Derby [17] described a pear-shaped translucent cyst, slightly smaller than the disk, with a greenish reflex, in a man aged 40. The cyst consisted of a rounded prominence on the temporal side of the disk.

Stieren [18] in 1933 reported a cyst on the nerve head of a 6 year old Negro girl. About 2 disk diameters above the macula there was a bluish white cyst about 1½ disk diameters in circumference which seemed to arise in opaque nerve fibers. It was elevated about 5 diopters and resembled a frosted light bulb.

REPORT OF A CASE

The cyst that I observed was discovered accidentally. A report of this case follows:

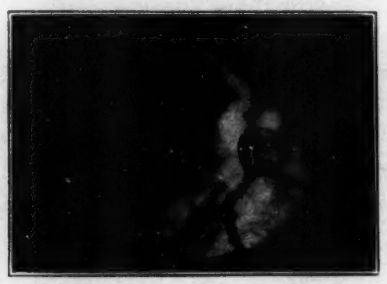

Fig. 2.—The cyst in focus. The vessels of the fundus can be seen through the transparent cyst.

A young married woman of 25 came to me in February 1938 because of headache. During an indirect examination of her fundus with an undilated pupil a shadow was seen floating across the fundus. She had never had ocular symptoms, and the cyst had never interfered with vision. The vision was 20/20, and under cycloplegia with homatropine hydrobromide, she accepted only a + 0.50 sphere in each eye, with vision of 20/20.

Examination of the right eye showed a prepapillary membrane extending over the nasal edge of the disk like a veil, nearly hiding the vessels, but they could be seen indistinctly through it and appeared normal. The remainder of the fundus was normal with the exception of a round floating shadow, like that of a cloud on the ground of a sun-lighted field. The shadow was cast by a round semitransparent cyst floating freely in the vitreous, and it was seen best with a lens of from 8 to 10 diopters in the ophthalmoscope. Observed directly, it seemed to have smudges of pigment over its edges and streaks and spots of pigment over its surface. If observed more closely over the edge of the dilated pupil, with some of the light reflected from the iris striking it, it appeared as a gilded, shiny pearl-like ball. It seemed to have plaques of hyalin-like deposit in its transparent capsule. It rotated on its vertical axis, was freely movable and was slightly

17. Derby, G. S.: Tr. Am. Ophth. Soc. **12**:827, 1909-1911.
18. Stieren, E.: Tr. Am. Ophth. Soc. **31**:116, 1933.

heavier than the vitreous, sinking downward out of sight when the eye was quiet. When the patient put her head forward or backward the cyst could not be made to approach either the lens or the fundus but seemed limited in its motility to the central and lower portions of the vitreous. The cyst was transparent. The vessels of the fundus as well as the posterior capsular wall could be seen through it. The capsule of the cyst was thin and was seen only by contrast with the surrounding vitreous.

The remainder of the vitreous was normal; the other media, the lens, aqueous and cornea, were clear. The slit lamp did not reveal the cyst or show any abnormalities in the vitreous.

Examination of the left eye revealed a slight prepapillary membrane, but not as marked as that of the right eye. The remainder of the fundus and the media were normal.

Since then I have observed this cyst at frequent intervals. There have been no changes in the appearance of the fundus or the cyst or in the visual acuity of the affected eye. Because of this observation, I feel justified in presenting this case as one of congenital free floating cyst of the vitreous.

COMMENT

The apparent pigmentation of the cyst is an illusion. Observed on the light background of the fundus, the shiny hyalin-like plaques of its surface appear in silhouette as streaks and spots of dark pigment. Observed directly, with the light reflected from the edge of the pupil, as is best seen in the drawing, this may be wrinkling of the capsule of the cyst, as it has contracted in size. Shine [3] reported the cyst that he observed as of steel gray color. Hurwitz,[5] in observing his reported cyst with the slit lamp, described it as a silver-white glistening sphere. Meding,[6] who observed his cyst with the slit lamp, described it as having the appearance of a gilded ball.

In reviewing the origin and development of the vitreous, it seems probable that the cysts are remnants of the primary vitreous rather than detached ciliary processes.

Their usual location in the central and lower part of the vitreous corresponds to that of the hyaloid remnants. The ciliary body and the tertiary vitreous are separated from the main body of the vitreous by condensation and Egger's line. This would almost preclude the possibility of such a cyst located in the central portion of the vitreous being a cyst of the ciliary process. The primary vitreous has the degenerated hyaloid remnants with its glial sheath from the ectoderm of the optic disk and its mesodermal elements. This seems most likely to be the origin of the cyst described here as well as of other previously described cysts of the vitreous.

The pigmented appearance of the cyst is probably formed by its silhouette on a light background. Examined directly at the edge of the pupil rather than through the center, with light reflected from the margin of the iris, the cyst appears shiny, glistening and unpigmented.

An apparent wrinkling of its surface gives it areas of greater wall thickness, like hyaline plaques. These areas, viewed through the center of the pupil with the cyst appearing in contrast with the light background and illuminated by reflected light from the fundus, appear dark. This was borne out in Shine's case in which he was able to observe the cyst with the slit lamp (a globular, semitransparent, grayish cyst floating freely in the vitreous).

On the basis of the newer knowledge of the origin and development of the vitreous into primary, secondary and tertiary vitreous, described by Mann and others, the separation of the ciliary body from the usual site of such a cyst and the absence of pigment, the interpretation of the origin of these cysts as being necessarily "a degenerated adenoma of the ciliary process which broke loose into the vitreous," as considered by Alt, should be revised. Troncoso also was of the opinion that cysts in the vitreous originate from the uvea, which accounted for the accumulation of pigment on the surface of the cyst.

The associated prepapillary membrane in the case reported here suggests a remnant of the primitive epithelial papilla of Bergmeister, which forms the sheath of the hyaloid arteries and its branches. The presence of this membrane, the lack of pigment and the location of the cyst in the center of the vitreous suggest the primary vitreous as the site and origin of the cyst as opposed to the theory previously advanced, that the cyst probably originated from a degenerative adenomatous cyst of the vitreous processes.

OCULAR MANIFESTATIONS IN BRUCELLOSIS (UNDULANT FEVER)

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The following brief historical account of Malta fever (undulant fever, brucellosis) is given in a paper by Baltzan:[1]

An epidemic form of fever in man had long existed in the Mediterranean area and was especially noticed in the island of Malta. It was first described by Marston in 1861 and called "Mediterranean fever." But it was not until 1886 that Sir David Bruce proved the etiological factor, which he called *Micrococcus melitensis.* In honor of Bruce other organisms belonging to this group have been given the generic name of Brucella. Twenty years later it was recognized that the goat was the host, and that in herds this organism was the cause of abortion. In the human being the disease was variously termed Mediterranean, Gibraltar, Malta, undulating, and undulant fever. It was reported in America as early as 1897 and since epidemics were restricted to regions where goats were largely handled, it received the popular name of "goat fever."

Bang, a Danish veterinarian, succeeded in isolating the causative agent of abortion in cattle in 1897. Its pathogenicity for man was, however, not fully recognized until nearly twenty-five years later, although earlier, in 1911, Schroeder and Cotton reported finding the abortion bacilli of Bang in milk sold for consumption, and suggested this might result in human infection. In 1914 Traum isolated the causative agent of abortion in swine. The question was not raised for some time afterwards whether there was any relationship between these organisms either to one another or to man.

Heretofore, three organisms were known to affect separately abortion in goats, cattle, and dogs. Only one of these, *Brucella melitensis,* the caprine or goat variety, was already proved a cause of fever in man. In 1918, Alice Evans, at Washington, demonstrated the intimate morphological, cultural, and biochemical relationships of the goat and cattle (Bang's) organisms. In consequence of this investigation the Brucella-like organisms originating from goats, cattle, and swine were designated as varieties of the same genus. Then, in 1924, Keefer in Baltimore reported a case of undulant fever in a patient who had had no contact with goats. The infection was the bovine type. Since then the porcine strain has also been recovered in human disease, and even known to be more virulent and more readily acquired from contaminated material, and not only by ingestion.

A perusal of Bruce's[2] brief paper, "Notes on the Discovery of a Microorganism in Malta Fever," compels admiration for this British

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Read at the Seventy-Fourth Annual Meeting of the American Ophthalmological Society, San Francisco, June 9, 1938.

1. Baltzan, D. M.: Experience with Fifty-Seven Brucellosis Infections in Saskatchewan, Canad. M. A. J. **36**:258, 1937.

2. Bruce, D.: Note on the Discovery of a Microorganism in Malta Fever, Practitioner **39**:161, 1887.

army surgeon who, practically unaided and with primitive laboratory equipment, gave impetus to a train of investigation which has led to results of immense importance to veterinary and medical science.

In 1918 Alice Evans [3] established the essential identity of Brucella melitensis and Brucella abortus. The following statements from her paper are, in the light of the later discovery of the pathogenicity of Br. abortus for human beings, truly prophetic:

> The very close relationship between B. abortus and an organism pathogenic to human beings adds new interest to the subject of the possible pathogenicity of B. abortus to human subjects. Considering the close relationship between the two organisms and the reported frequency of virulent strains of B. abortus in cow's milk, it would seem remarkable that we do not have a disease resembling Malta fever prevalent in this country. . . . Are we sure that cases of glandular disease, or cases of abortion, or possibly diseases of the respiratory tract may not sometimes occur among human subjects in this country as a result of drinking raw cow's milk?

Up to 1924 interest in the disease was confined largely to veterinarians. After Bang's discovery of Br. abortus, investigations were carried on in veterinary laboratories throughout the world to determine the incidence of the disease in herds of cattle. It is conservatively estimated that between 15 and 20 per cent of cattle in the United States are infected with this organism. Many seemingly normal animals are carriers. If an animal aborts it does not ordinarily show other clinical signs of the disease.

Carpenter and King [4] found that 20.4 per cent of the raw milk supply of three counties in central New York showed infection with Br. abortus. Gilbert and Coleman [5] studied undulant fever in New York state, where two million people have a raw milk supply. Several hundred cases of undulant fever are diagnosed annually. They expressed the belief that only one tenth of the actually existing cases are recognized. In most of the cases in New York the disease was due to organisms of the bovine type. Most of the patients had no contact with cattle. Consequently, raw milk seemed to be the source of the trouble.

Keefer [6] was the first to isolate Br. abortus from the blood of a human being who had suffered from a continuous fever of several weeks' duration.

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3. Evans, A.: Further Studies on Bacterium Abortus and Related Bacteria: II. A Comparison of Bacterium Abortus with Bacterium Bronchiseptus and with the Organism Which Causes Malta Fever, J. Infect. Dis. **22**:580, 1918.

4. Carpenter, C. M., and King, M. J.: Symposium on Undulant Fever, New York, American Public Health Association, 1929.

5. Gilbert, K., and Coleman, M. B.: Recent Cases of Undulant Fever in New York State, J. Infect. Dis. **43**:273, 1928.

6. Keefer, C. S.: Malta Fever Originating in Baltimore, Bull. Johns Hopkins Hosp. **35**:6, 1924.

Human beings may become infected (*a*) by consuming unpasteurized milk or other dairy products containing Br. abortus and (*b*) by infection through abrasions in the skin and other wounds. From the digestive tract the organism invades the mucous membrane, passing thence into the blood stream or indirectly by way of the lymphatic system. The lymphatics and the blood stream may become invaded by infection from the tonsils. Carpenter and Boak [7] found the organism in 8 of 56 pairs of human tonsils after surgical removal. This finding has been confirmed by other investigators.

Great differences in susceptibility exist. For instance, only one infection may occur in a family although all the members may be drinking the same milk. Men working in abattoirs may develop an active immunity; others, working under the same circumstances, may contract the disease. These infections could almost certainly be prevented by the workers' wearing rubber gloves. From 5 to 7 per cent of persons living in the country or in smaller towns where most of the milk sold is not pasteurized carry Br. abortus antibodies in their blood. Some of these have developed an active immunity resulting from an unrecognized mild infection not causing symptoms of the disease.

The Br. abortus is found in goats, sheep, swine and horses. The bovine strains are extremely pathogenic for the human family. Attempts have been made in Europe to immunize laboratory workers by injecting intracutaneously 0.1 cc. of a suspension containing approximately 5,000,000 killed organisms per cubic centimeter. There is good evidence to show that 50 per cent of all veterinarians are infected.

Hughes [8] in 1897 described three general types of this infection: (1) the persistent type in which the fever continues intermittently for several weeks or months; (2) the undulant type, marked by exacerbations of fever at regular intervals; and (3) the pernicious or fulminating type in which the temperature rapidly rises to 106 F. or even higher. The last type, rare in this country, is, as a rule, fatal. Evidence is accumulating to show that the first and second types may drift into a chronic form, enduring for many years. The sufferer may have long periods of well-being, followed by periods of lassitude, malaise, generalized weakness, arthritic pains and headache.

The period of incubation is from five to fifteen days. The onset is gradual, with weakness, general malaise, headache, backache, anorexia and constipation, followed by fever, chills, sweats, aching of the muscles, bones and joints and loss of weight. One characteristic is that the

7. Carpenter, C. M., and Boak, R. A.: The Isolation of Brucella Abortus from Tonsils, J. A. M. A. **99**:296 (July 23) 1932.

8. Hughes, M. L., cited by Bierring, W. L.: Undulant Fever: Clinical Characteristics Based on a Study of One Hundred and Fifty Cases Observed in Iowa, J. A. M. A. **93**:897 (Sept. 21) 1929.

appearance and general condition of the patient may be surprisingly good despite a rapid pulse and high temperature.

Physical signs are enlargement of the spleen and lymph glands (less frequent), swelling of the joints without redness and pain and abdominal pains suggestive of appendicitis or cholecystitis.

Harris [9] expressed the belief that "clinically Brucellosis is to be suspected in any obscure acute or chronic ailment. The symptomatology is tremendously variable and in any given case may simulate any one of a long list of acute and semi-acute diseases." This author listed 41 diseases with which it may be confused. He stated further: "The infection may be so mild as to completely escape detection and indeed may exist in thousands of patients in so minimal a degree that the patient never seeks medical advice. . . . These mild infections may at any time become virulent after months or years of latency."

Two of my internist colleagues in St. Louis have been applying a cutaneous test for brucellosis to patients who are seen now and again with all sorts of vague and unexplainable symptoms—the type of patient who makes life miserable for the physician. In a surprisingly large number of such patients a positive reaction has been elicited to this test for present or past infection with Br. abortus.

DIAGNOSIS

In the present state of knowledge a positive diagnosis of brucellosis cannot be made on clinical appearances alone. The aid of a good pathologic laboratory manned by pathologists conversant with the technic of the various tests is essential.

Opsonocytophagic Test.—In order to inhibit the normal opsonins, the blood of the patient is mixed with sodium citrate. Two-tenths cubic centimeter of 20 per cent sodium citrate in saline solution is prepared. To this is added 5 cc. of blood. A standard strain of Brucella which has been incubated for forty-eight hours is mixed with the citrated blood, and the mixture is incubated at 37 C. for one hour. Ordinary blood smears are then made and stained. Fifty white cells are examined to determine the number of organisms that have been picked up by each cell. From this is calculated the Foshay [10] opsonocytophagic index. In most cases the index number seems to parallel roughly the state of the patient's resistance to the disease.

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9. Harris, H. J.: Undulant Fever (Brucellosis): Difficulties in Diagnosis and Treatment; Supplementary Report on Fifty-One Cases with Observations on One Hundred and Twenty Additional Cases, New York State J. Med. **37**:1295, 1937.

10. Foshay, L., and Le Blanc, T. J.: Derivation of Index Number for Opsonocytophagic Test, J. Lab. & Clin. Med. **22**:1297, 1937.

Blood Agglutination Test.—The agglutination test of the blood is of value only if it is positive. In the vast majority of cases of chronic brucellosis it is negative (over 90 per cent in one series). Ordinarily an agglutination titer is found relatively early and only during the acute stage of the disease. Agglutination tests may remain negative during the entire course of the disease. As Harris[9] stated: "The partial agglutination with B. abortus in patients who present a clinical picture of Brucellosis is just as significant as is agglutination in higher dilutions of the serum. To ignore this point is to overlook a majority of the cases of Brucellosis that come under observation." It should be remembered that the agglutination test for brucellosis is not a test for the presence of organisms but only for the determination of specific agglutinins in the blood.

Cutaneous Test.—A small quantity of killed bacillary suspension or Huddleston's brucellin is injected intradermally into the forearm. The reaction begins within twenty-four hours or even earlier and appears as a rapidly spreading area of redness with an indurated center, usually with considerable edema. Heat, pain and itching are present as a rule; infrequently, sloughing of the superficial tissues occurs. Any reaction persisting to the third day is considered positive.

After the cutaneous test the patient's reaction is variable. Twenty-five per cent show no reaction; 10 per cent feel better. In 65 per cent there is an intensification of all symptoms. Rarely severe constitutional reactions follow.

A positive reaction to any laboratory test does not prove the existence of active brucellosis but indicates that the patient has or has had the disease. The cutaneous test is the most sensitive of the tests and is of great value in detecting chronic inactive brucellosis with few or ill defined symptoms.

THERAPY

The therapy for brucellosis has not kept pace with the rapid increase in the knowledge of the symptomatology, bacteriology and laboratory diagnosis of the disease. Chemotherapy has proved disappointing. Fever therapy, by means of the Kettering hypertherm, has been effective in some cases of acute brucellosis. It probably acts by raising the phagocytic power of the blood. According to Newman:[11] "Possibly certain chemical changes take place within the tissues which either stimulate immune reactions or else render the tissues unsuitable for the continued growth and reproduction of the bacilli."

Specific serums and commercial vaccines have not always proved effective. Recently Dr. Lee Foshay, of the Cincinnati General Hos-

11. Newman, H. G.: Diagnosis and Treatment of Undulant Fever, Radiol. Rev. & Mississippi Valley M. J. **60**:31, 1938.

pital, developed an effective serum for the treatment of the disease in the acute stage and a vaccine for treatment in the chronic stage. The serum and vaccine are not yet on the market and hence not available to the general medical profession.

The occurrence of ocular manifestations in the course of brucellosis is now well established. It is my impression that comparatively few ophthalmologists are taking advantage of the opportunity to determine by laboratory methods the presence or absence of past or present infection with Brucella. Much information can be gained by applying the simple intradermal test now available. Full data, however, can be secured only with the aid of a laboratory equipped to perform the opsonophagocytic and agglutination tests.

REPORTS OF CASES

CASE 1.—In 1917 H. G. N. was employed as a research assistant in animal pathology at the Missouri State Agricultural College. His work consisted of handling laboratory cultures of abortion bacilli from both cattle and swine. He was constantly exposed to infected experimental animals both in the field and in the laboratory. At that time the bacillus was considered harmless to man; consequently no precautions were taken to prevent infection. While thus engaged, he became ill with a strange malady which began with fever, weakness and night sweats. His right eye became inflamed; the diagnosis was phyctenular conjunctivitis. Tuberculosis was suspected but ruled out by roentgenographic and routine examinations.

After these symptoms had persisted for several months, there developed a high fever and a marked cutaneous rash which was regarded as scarlet fever. The absence of lesions in the throat and the disappearance of the rash in a few hours led to the abandonment of this diagnosis. Next appeared marked jaundice and clay-colored stools, finally terminating in the patient's recovery after one day in coma.

In 1918 the man had severe tonsillitis, followed by influenza with pneumonia. After recovery he was restored to comparative good health. Repeated attacks of sinusitis added to his discomfort. In 1925 his tonsils were removed, and later, because of tenderness in the right lower abdominal region, appendicitis was suspected and an appendectomy was performed.

He first came under my observation in April 1930, when he was a medical student in St. Louis. At this time he presented in the right eye a small phlyctenule adjacent to, but not invading, the cornea, at 4 o'clock. Four days later the eye was well. In March 1931 he returned with a faintly staining marginal corneal lesion extending from 3 to 4 o'clock. Again recovery occurred in a few days. A similar but even less marked attack occurred on Nov. 12, 1934; and again there was a slight attack in April 1935. He felt that there was some connection between the exacerbations of sinusitis and the corneal manifestations; during each attack the rhinologist shrunk his nasal mucosa and on one occasion washed out his right antrum. In January and February 1936 he had his most severe attack of corneal trouble. A linear marginal corneal ulcer developed at 4 o'clock. The ulcer continued to spread upward and downward, and five days later about one sixth of the circumference of the cornea was involved. He was hospitalized and given general ultraviolet therapy, and the lesion was exposed to ultraviolet

radiation with the Hildreth lamp. (Dr. H. Rommel Hildreth carried out this part of the treatment.) The eye was kept atropinized for two and a half weeks. The lesion finally healed completely. There have been no subsequent recurrences.

In the summer of 1937, twenty years after the acute episode, the man volunteered to act as a control for a cutaneous test for undulant fever made on a subject who was thought to have this condition. This person had no reaction, but the control had, within twenty-four hours, a general reaction, with chills, fever and severe pain in the muscles for a whole day. In addition, a marked local reaction occurred, with swelling, induration and edema around the point of injection, which finally ended in a deep slough. An opsonocytophagic index showed that over 90 per cent of his leukocytes were picking up abortus bacilli. A low white cell count with a high percentage of monocytes was also present, this blood picture being typical of the disease in the chronic stage. The symptoms subsequent to the period of acute infection consisted of recurring attacks of pain in the muscles, joints and nerves. These attacks occurred on an average of three or four weeks. Great improvement occurred after the administration of Foshay's vaccine.

CASE 2.—Mrs. J. F. R., aged 51, came under observation on Jan. 10, 1938, with the complaint of disturbed vision in the right eye. Vision in this eye was 6/7.5 with a +2.25 sph. There was definite metamorphopsia. Ophthalmoscopic examination showed the retinal veins to be engorged but not tortuous. The arterioles in the macular region were numerous and tortuous. In the lower part of the macular region and encroaching on the fovea there was a slight subretinal elevation, about ⅔ disk diameter. The upper part of the lesion skirted the fovea, and here there were a few small round hemorrhages. The left eyeground was normal, and vision with correction was normal. Her physician reported that her general condition as excellent.

At this time she was aware of the existence of a number of bad teeth, and during February and March three upper and five lower teeth were extracted. Vision dropped to 6/30, eccentric. The reactions to the Mantoux test with two dilutions of tuberculin were entirely negative, as were the reactions to the Wassermann and Kahn tests. The opsonic tests with Br. abortus showed a Foshay index of 23, indicating a low resistance. The reaction to the cutaneous test for Br. abortus was strongly positive. So far there has been no opportunity to try out the specific vaccine on this patient.

CASE 3.[12]—K. W., a housewife aged 70, entered St. Luke's Hospital early in 1937. Three or four weeks prior to entrance she observed a swelling about the size of a pea on the right side of her forehead just within the hair line. This extended in the direction of her right ear and was tender to pressure and painful at night. There was a constant fever, the temperature ranging from 100.5 to 101 F.

Examination showed firm cordlike structures on both sides of the forehead running up to the midline of the frontal region. They were not connected. They were probably situated within the skin, but their true nature was not determined. Shortly after the patient's admission to the hospital, Dr. Shahan found acute optic neuritis in the right eye, with partial loss of the left field. Vision was reduced to 8/30. Three abscessed teeth were extracted. Neurologic examination gave essentially negative results. There were no nasal appearances to warrant treatment or operation. Within a few days the optic neuritis showed improvement, and the patient was dismissed from the hospital.

12. Dr. William E. Shahan gave me permission to report this case.

On reentrance five weeks later she complained of pain in many joints and in the muscles of the thighs. There had been considerable pain on motion, but at the time of her admission this had ceased. There were also night sweats and an afternoon rise of temperature and headaches. A vaccine made from cultures of Br. abortus was injected intradermally. A marked induration and a large area of erythema adjacent to the site of injection followed. Dr. Shahan found that the optic neuritis had subsided, leaving a slightly pale disk. The patient was put on small doses of Foshay's Br. abortus vaccine, which were continued by her physician for several months, with marked improvement in the symptoms. The Foshay index rose from 61 to 87 in three months.

The agglutination tests were negative for Bacillus typhosus, Bacillus paratyphosus A and B, Br. abortus and Br. melitensis. The reactions to the Wassermann and Kline tests were negative. A roentgenogram of the chest showed evidence of interlobar pleurisy and arteriosclerotic arcus aortae.

CASE 4.[13]—A married woman aged 34 complained of a feeling of malaise. She suffered from general loss of energy and a sense of discomfort from the late spring of 1934 till August of the same year. There was no examination or treatment until August, at which time she noticed a blurring of vision in the left eye. At this time she was found to have a daily low grade fever, the temperature ranging from 99 to 100 F. The vision in the left eye was 20/70, owing to a central retinochoroiditis. Examinations in late August 1934 were positive for undulant fever. During September and October she received antimelitensis vaccine (Simpson). This had little appreciable effect on her general symptoms or on the ocular condition. In January 1935 she received 20 cc. of antimelitensis serum (Foshay) in two doses intravenously. There was a questionable abatement of symptoms for the next two or three weeks. She received no more treatment, but in the course of several months the fever and general debility subsided, until by the fall of 1935 she was free from all systemic symptoms. The condition of the eye remained stationary from August 1934 to October and then gradually improved. By the late spring of 1935 the vision had improved to 20/25 and has remained so.

I have been able to gather from the literature the following instances of ocular complications appearing in cases of undulant fever. In each case the clinical diagnosis was confirmed by one or more of the laboratory tests and also by the exclusion of other infections that might conceivably have borne a causative relation to the ocular malady.

AURAND'S CASE.[14]—The patient, a woman, sought consultation for diminution of vision. She had been ill for ten months. The original diagnosis was "grip." Various treatments failed to check her malady, which was characterized by continued fever, great thirst and anorexia. Culture of the blood revealed melitococci. In the course of the disease, which was finally treated with antimelitococcic vaccine, iritis developed, which finally yielded, leaving deposits of fine pigment on the anterior capsule of the lens. The visual acuity was little impaired.

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13. Dr. H. G. Newman gave me permission to report this case, which was observed by Dr. S. C. Fulmer, of Little Rock, Ark.

14. Aurand, L.: Iritis au cours d'une fièvre de Malte, Bull. Soc. d'opht. de Paris, April 1936, p. 393.

AUBARET AND ROGER'S CASE.[15]—A woman aged 36 had fever of three months' duration accompanied by profuse perspiration, headache, stiffness of the neck, nausea, epigastric pain, constipation and backache. Early in the disease the vision deteriorated. In eight or ten days blindness was almost complete but was followed by slight improvement. Laboratory examination eliminated malaria, typhoid and syphilis; melitococci were found on culture. Vision was 1/50 in each eye. Ophthalmoscopic examination showed atrophy of the optic nerve, with narrowed vessels. There were signs of meningeal irritation. A variety of treatments failed to help. Five months after the onset of the disease melitococcic vaccine was used, followed by improvement in the general condition and slight improvement in the vision.

VILLARD AND PECH'S CASES.[16]—CASE 1.—A girl of 15 had a moderate fever. Culture of the blood revealed melitococci. Three weeks after the beginning of the illness the right eye became red, and vision rapidly diminished. Hypopyon was noted. There were numerous synechiae, which yielded to atropine. A yellowish mass was found in the vitreous. In spite of vigorous treatment with foreign proteins, intravenous injections of mercuric cyanide, etc., sight was lost, and the eye eventually atrophied.

CASE 2.—A woman aged 33 had loss of weight accompanied by cough. The tentative diagnosis was tuberculosis. Culture of the blood showed melitococci. Three months later the right eye became painful. Examination showed an acute iridochoroiditis with a blocked pupil. Vision was limited to perception of light. Treatment was unavailing, and blindness was complete five months later.

BERGMARK'S CASE.[17]—A man aged 55 began in May 1938 to have severe headache and a continuous fever. The liver and spleen were palpable. Agglutination and complement fixation tests, both with the blood and with the spinal fluid, were positive for Br. abortus. In the right fundus oculi there was a small hemorrhage and beside it a greenish yellow exudate. The diagnosis was septic retinitis. There were many neurologic signs. Eight months after the patient's admission to the hospital the optic nerve on both sides was well advanced toward atrophy. Death occurred from intestinal hemorrhage two years after admission. Autopsy revealed chronic meningoencephalitis.

BINGEL AND JACOBSTHAL'S CASE.[18]—A man aged 32, who had been drinking raw milk frequently for several months, complained of general fatigue, lack of interest in life, loss of appetite and occasional headache. A severe headache suddenly developed, accompanied by vomiting and fever, the temperature being high. On examination of the nose and sinuses nothing was found. Examination of the eyegrounds showed choked disks amounting to 2 or 3 diopters. Culture of the blood revealed Br. abortus. Later cultures of the spinal fluid also revealed the organism. The history is incomplete in regard to the outcome of the ocular condition.

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15. Aubaret, E., and Roger, H.: Névrite optique, mélitococcique, Rev. d'oto-neuro-opht. **9**:50, 1931.

16. Villard, H., and Pech: Deux cas d'ophthalmie métastatique d'origine mélitococcique, Bull. Soc. d'opht. de Paris, December 1929, p. 676.

17. Bergmark, G.: Ueber Nervensymptome bei Febris undulans (Bang), Acta psychiat. et neurol. **6**:387, 1931.

18. Bingel, A., and Jacobsthal, E.: Ueber Meningitis bei Banginfektion: Ihr klinisches und bakteriologischserologisches Bild, Klin. Wchnschr. **12**:1093, 1933.

CANNAVÒ'S CASE.[19]—The patient aged 26 contracted the disease while in contact with herds of sheep and cows, supposedly infected with Brucella. His trouble began in July 1934, with continued fever and pain in the joints. All serologic tests other than for Brucella gave negative results. The serologic test for Brucella was positive with a dilution of 1:200. Between the fortieth and the fiftieth day of the illness vision in the left eye deteriorated. A little later a diagnosis was made of choroiditis with floating material in the vitreous. Cannavò is positive that all etiologic factors other than Brucella could be ruled out. Vision was finally reduced almost to blindness.

COHEN BOULAKIA'S CASES.[20]—CASE 1.—A youth aged 18 had undulant fever of eight months' duration. The diagnosis was confirmed by positive laboratory tests. For fifteen days he had noticed a veil in front of his left eye. This phenomenon lasted two or three hours and then disappeared. Vision decreased rapidly to counting of fingers at 30 cm. Ophthalmoscopic examination showed that the edges of the disk were edematous. Eight days later the entire retina was diffusely edematous. Still later there were vast plaques of retinal hemorrhage. Finally, massive hemorrhages into the vitreous occurred, with secondary glaucoma, necessitating iridectomy. The final result was atrophy of the optic nerve.

CASE 2.—A youth aged 17 during recovery from melitensis complained of diminution of sight in the right eye. Ophthalmoscopic examination showed a grayish discoloration of the macular zone. This was surrounded by a small whitish halo, equal on the two sides and assumed to be of congenital origin. The amblyopia lasted three weeks, and vision was completely restored.

GODWIN'S CASE.[21]—A woman aged 55 had been ill two and a half months and had had a temperature of about 103 F. for the first three weeks of that time. The diagnosis of Malta fever was confirmed by agglutination tests. Vision in the right eye was 6/20, eccentric. She presented a definite papillitis in the right eye—edema of the nerve head and tortuosity of the retinal veins. The left fundus showed slight blurring of the margins of the disk and moderate tortuosity of the veins. After initial improvement, there was a relapse. Full vision was not regained.

LEMAIRE'S CASE.[22]—A woman aged 25 first suffered from lumbago, backache, pain in the lower extremities and fever. The diagnosis was grip. Five days after the onset, severe headache developed, which resisted medication. Three weeks later diplopia and strabismus were noted, and the eyegrounds showed bilateral congestion of the optic disks. The diplopia was homonymous. The diagnosis was established by lumbar puncture. All serologic tests were tried, but only that for melitococcus gave positive results. (According to Rutherford, this is the first recorded case of papilledema in undulant fever.)

LUNDSGAARD'S CASE.[23]—A farmer aged 64 had a herd of cattle which was attacked with contagious abortion. He stated he had not drunk unboiled milk

19. Cannavò, F.: Complications ocularis de la fièvre ondulante, Rev. prat. d. mal. d. pays chauds **15**:424, 1935.

20. Cohen Boulakia, S.: Neuro-rétino-choroïdite d'origine mélitococcique, Ann. d'ocul. **163**:702, 1926.

21. Godwin, D. E.: Optic Neuritis in Malta Fever, Am. J. Ophth. **12**:747, 1929.

22. Lemaire, G.: Méningite à mélitocoques: Altérations importantes du liquide céphalo-rachidien; hyperglycorachie; guérison, Bull. et mém. Soc. méd. d. hôp. de Paris **48**:1636, 1924.

23. Lundsgaard, K. K. K.: A Case of Iridocyclitis in Association with Febris Undulans Nostra, Acta ophth. **6**:408 1928.

but had taken some unboiled cream. His symptoms were cough and fever and, a fortnight later, a painful left eye. On examination he was found to have marked iridocyclitis with vascularization of the iris. There were interlacing streaks in the lower part of the cornea, reminding Lundsgaard of a type of iridocyclitis with parenchymatous keratitis which he had seen in association with parotitis. The results of all serologic examinations were negative, but the agglutination test for Br. abortus was positive.

Levy and Uzan's Case.[24]—During the second month of undulant fever, meningitis with paralysis of the sixth, seventh and tenth pairs of nerves made their appearance. Ophthalmoscopic examination showed bilateral papilledema. The paralyzed muscle of the eye improved, and eventually there was complete subsidence of the papilledema.

Aubaret and Guillot's Case.[25]—In a case of Mediterranean fever with ocular complications the field of vision was narrowed concentrically. Both optic nerves showed edema. Recovery took place without any special local therapy.

Madievskaya's Case.[26]—A girl aged 13 years had a bilateral ocular condition, characterized by photophobia, lacrimation and pain. She had had a general illness, characterized by fever, malaise, headache and loss of appetite, which began nine months prior to the onset of the ocular symptoms. Malaria was suspected, but no plasmodia were found. In spite of this, she was put on antimalarial treatment, with progressive deterioration in the ocular condition and lowering of vision to 1/10. Ocular examination several months later showed evidence of subacute iritis with synechiae and deposits on the posterior surface of the cornea. The vitreous was clouded. The optic disk was yellowish gray, and the vessels were dilated and tortuous. The patient had a complete medical study, the results of which were wholly negative except for a positive reaction to tests for the presence of Micrococcus melitensis and Br. abortus. The author concluded that this was a true case of undulant fever with complications in the form of iridocyclitis and neuroretinitis of both eyes.

Roger's Cases.[27]—Two cases of paresis of the external ocular motor nerve in the course of melitococcic meningitis are reported.

Villard, Viallefont and Temple's Case.[28]—A man aged 33 complained of rapid and progressive deterioration of vision. He gave a positive reaction to a seroagglutination test for undulant fever. The temperature was high, but the fever yielded to the first injection of melitococcic vaccine. Ocular examination showed a white papilla, small vessels, myopia of 10 diopters and discrete myopic chorioretinitis in the right eye. Vision was reduced to the counting of fingers at 10 cm. The vision rapidly deteriorated to 1/10 in the left eye.

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24. Levy and Uzan, cited by Cohen Boulakia.[20]

25. Aubaret, E., and Guillot: Névrite optique infectieuse bilatérale au cours d'une fièvre exanthématique du littoral méditerranéen, Bull. et mém. Soc. franç. d'opht. **46**:402, 1933; Zentralbl. f. d. ges. Ophth. **31**:492, 1934.

26. Madievskaya, E. Y.: Ocular Complications of Undulant Fever, Sovet. vestnik oftal. **6**:183, 1935.

27. Roger, H.: Les complications méningées de la mélitococcie, Paris méd. **2**:257, 1932.

28. Villard, H.; Viallefont, H., and Temple, J.: Complication rare de la fièvre de Malte: Syndrome tabétique et névrite rétro-bulbaire avec hypertension artérielle rétinienne, Arch. Soc. d. sc. méd. et biol. de Montpellier **14**:224 (Feb.) 1933.

The author's summary follows: "In a subject of 33 years a characteristic undulant fever provoked after a few months a diminution of visual acuity ending in a quasi blindness with contraction of the visual field, with evidences of retinal angiosclerosis. Neurologic examination revealed an abolition of reflexes and disturbances of gait which suggested tabes. The cerebrospinal fluid showed turbidity."

Rizzo's Case.[29]—A youth aged 20 had been ill for four months. The symptoms were weakness and numbness; later chilly sensations developed with fever, which assumed the course of a continuous fever with remissions in the morning. Diplopia was noticed one month after the illness began. The serologic tests were negative for typhoid, paratyphoid and syphilis, but were positive for undulant fever. Ocular examination showed the right pupil to be wider than the left, the reaction was sluggish, and there was paresis of the right external rectus muscle. Vision was 1/50, eccentric. There was papillary swelling of the optic disk, and the vessels were normal in caliber and course. The visual field of the left eye was restricted markedly and concentrically for white and colors. There was a central scotoma for red and green. Vision was 1/10. The optic papilla was slightly edematous, with blurred edges and swollen veins. The retina surrounding the disk was edematous.

Mossa's Case.[30]—A woman aged 30 became ill, the symptoms being a sense of debility, lack of appetite and emaciation. When she was seen on March 9, 1934, each eye was completely blind. There was paresis of the abducens nerve on one side. The pupils were slightly dilated and did not react to light. The diagnosis was blindness due to lesion of the primary optic centers. The results of roentgen examination of the head were indeterminate. The patient recovered from the Malta fever, but the optic disks remained completely atrophic. The final diagnosis was blindness due to retrobulbar neuritis caused by Malta fever.

De Jong's Case.[31]—A farmer aged 27 suffered from weakness, fatigue, frontal headache, generalized aches and pains, constipation, nervousness, anorexia, urinary frequency and nocturia. He had a temperature which ranged from 100 to 102 F., and he perspired excessively. He stated that some of the cattle in his neighborhood had been infected with contagious abortion and that his own cow had aborted. Agglutination tests of the blood for the organisms of the Brucella group were as follows: Br. abortus with a dilution of 1:320; Br. suis with a dilution of 1:320, and Br. melitensis with a dilution of 1:120. The phagocytic action of the patient's polymorphonuclear cells on Br. abortus was marked in 94 per cent of the cells and moderate in 6 per cent. He improved without treatment. It was believed that the active stage of the disease was nearly at an end.

The patient was readmitted to the hospital five months later complaining of headache, vertigo, nausea and vomiting. The left pupil was larger than the right, with bilateral weakness of the external rectus muscles. There was neuroretinitis, with blurring of the margins of the disk, slight elevation of the nasal half of the disk and five capillary hemorrhages bilaterally. He was given polyvalent serum

29. Rizzo, A.: Nevrite ottica nel corso di una febbre di Malta, Riv. san. siciliana **24**:1352, 1936.

30. This case was reported at a meeting of the Italian Ophthalmic Society in 1934.

31. De Jong, R. M.: Central Nervous System Involvement in Undulant Fever, with Report of a Case and Survey of the Literature, J. Nerv. & Ment. Dis. **83**: 430, 1936.

made up of the organisms of Br. melitensis and Br. abortus of bovine origin, after which he showed improvement.

Summary: In a 27 year old farmer vertigo, diplopia, tinnitus and vomiting developed eight months after the onset of undulant fever. Clinically he showed neuroretinitis, weakness of ocular motion, nuchal rigidity and tremor of the extremities. The spinal fluid showed a pleocytosis of from 63 to 200, mainly lymphocytes, and an increased protein and a decreased dextrose content. Br. abortus was cultured from the spinal fluid. The patient showed slight improvement after treatment with palliative measures and antiserum.

McCullagh and Clodfelter's Case.[32]—A boy 13 years old had an influenza-like infection. After returning to school a severe headache developed, and he could not see well. Both optic disks were choked; the right eye was blind, and there was little vision in the left eye. A right subtemporal decompression was done. The fever persisted, and the agglutination test for undulant fever was positive. The patient made a slow recovery, with restoration of sight. He lived on a farm and consumed a great quantity of raw milk.

Rutherford's Cases.[33]—Sixty-three patients with undulant fever were examined ophthalmoscopically; 3 showed changes in the disk.

Case 1.—Ophthalmoscopic examination of the patient in this case showed bilateral papilledema, normal visual acuity and contraction of the right field nasally and of the left field concentrically. The clinical diagnosis was encephalitis. Death occurred suddenly fourteen months after the patient's admission to the hospital. The agglutinin test with postmortem blood was positive for undulant fever.

Case 2.—The patient was observed ten months after the beginning of symptoms, which included tingling sensations of the right foot, which spread upward to involving the entire right side and were followed by headache. Subsequent attacks occurred, first on one side and then on the other. There were attacks of unconsciousness. The headaches were accompanied by blurred vision and diplopia. The spinal fluid was under increased pressure, was cloudy and contained a few extracellular gram-negative organisms. Examination at the Johns Hopkins Hospital showed organisms resembling those of undulant fever. These were grown from the spinal fluid. Ophthalmoscopic examination showed the margins of the disks to be blurred, a hemorrhage above the right disk and numerous preretinal hemorrhages. The left fundus showed large hemorrhages and a preretinal hemorrhage. The clinical diagnosis of undulant fever was supported by laboratory tests. The patient died ten months after the beginning of his illness. The microscopic diagnosis was meningoencephalitis due to Br. melitensis variety suis.

Case 3.—Ophthalmoscopic examination showed normal central visual acuity and papilledema of 0.5 diopter in each eye. Later the papilledema increased in each eye. At the Mayo Clinic a parietotemporal exploration was made. No pathologic changes were found. Agglutination tests for undulant fever were positive. A final diagnosis was made of melitensis meningoencephalitis with residual hemiplegia. Rutherford commented: "Melitensis infection of the central nervous system occurs occasionally with or without ocular complications. In

32. McCullagh, E. P., and Clodfelter, H. M.: Encephalitis Due to Undulant Fever: Report of Four Cases, Ann. Int. Med. **10**:1508, 1937.

33. Rutherford, C. W.: Papilledema in Undulant Fever, J. A. M. A. **104**: 1490 (April 27) 1935.

three of sixty-three cases of undulant fever there were bilateral papilledema, an increase in the spinal fluid pressure, mononuclear pleocytosis, and evidence of infection of the central nervous system by some variety of the melitensis organism. . . . Papilledema is occasionally found in patients in whom the symptomatology is indefinite and leading signs are absent. It is in such cases that undulant fever should be considered in the differential diagnosis."

CARRANZA'S CASE.[34]—A boy aged 10 years had an illness of two months' duration. He was admitted to the hospital in a state of coma with spastic contraction of the right leg. The pupils contracted and were reactionless to light. On emergence from the coma the boy complained of seeing green lights. The disks were congested, with blurred margins. The diagnosis was undulant fever. The cutaneous test elicited a positive reaction. Treatment with high voltage roentgen therapy was given. The patient recovered.

ROGER'S CASE.[35]—A woman 28 years of age when seven and a half months pregnant had an intermittent fever. After a premature delivery the fever recurred and lasted four and one half months. She was convalescent for two months. She then had severe headache, nausea and vertigo. There was diplopia due to paralysis of the left external rectus muscle. Eight days later there was paralysis of the right external rectus muscle. The patient recovered. Melitococcic serum was used.

SELLA'S CASE.[36]—A man of 21 had symptoms of meningitis. On admission to the hospital ten days after his illness began he had dilated pupils. Bilateral optic neuritis was found. Complete recovery followed the intravenous administration of specific vaccines.

COMMENT

It will be noted that most ocular lesions occurring in the course of brucellosis do not destroy the integrity of the globe. Hence enucleation is not demanded. This fact explains the lack of any pathologic examination of a human eye that has been affected with brucellosis. Some interest therefore attaches to Orloff's investigation of the globes of guinea pigs which died of melitensis.

Orloff[37] examined the eyes of 19 guinea pigs ill with melitensis. Some presented ocular lesions in life. At the first sign of ocular participation circumcorneal injection was noted. There was slight central clouding of the cornea. The iris was more or less hyperemic; the pupil was occupied by a grayish exudate. Microscopic examination of the cornea showed in cases of slight involvement the following alterations: extensive desquamation of the epithelium in the central part, epithelial degeneration and formations of vacuoles in the nuclei at the periphery, formation of vacuoles in the peripheral endothelium and

34. Carranza, J. P.: Meningoencefalitis aguda, difusa melitocócica, Crón. méd., Lima **53**:281, 1936.

35. Roger, H.: Les complications cérébrales de la mélitococcie, Marseille-méd. **2**:591, 1929.

36. Sella, M.: Meningite acuta da infezione melitense: Efficacia del trattamento vaccinico per via endovenosa, Gior. di clin. med. **16**:466, 1935.

37. Orloff, K. C.: Melitokokkia (Malta Fieber) und Auge, Klin. Monatsbl. f. Augenh. **81**:582, 1928.

grave lesions of the endothelial cells, corresponding to the central clouding. In several cases the corneal lesions were much more pronounced, and the microscopic picture acquired a great similarity to that of syphilitic parenchymatous keratitis. The iris in the majority of cases was diffusely infiltrated, and there were numerous posterior synechiae.

The ciliary body appeared to be most affected; in all cases there was an infiltration of lymphoid and epithelioid cells. The vitreous was often fluid. In about half the cases the lens showed definite signs of inflammatory cataract. In the anterior portion of the choroid there were found hyperemia and here and there foci of infiltration. In the posterior portion of the uvea there was migration of the subretinal pigment with round cells and fibrin.

On the basis of these findings, Orloff stressed the practical importance of infection of the eye with melitensis, which clinically as well as pathologically seems to have a great similarity to ocular tuberculosis.

An immense amount of work has been done on brucellosis in the past twenty years. Those who have undertaken the study of the disease either in the laboratory or clinically have become enthusiastic about the possibilities and implications of this new malady; in fact, one is inclined to feel that some authors have allowed their enthusiasm to outrun their judgment. Evidence is accumulating, however, that some ocular maladies hitherto ascribed to other origins may be caused by brucellosis. The external ocular muscles, the cornea, the uveal tract, the retina and the optic nerve have all proved vulnerable. Who has not been thwarted in his most painstaking efforts to establish the cause of a chronic uveitis? Should not the ophthalmologist include in his list of possible etiologic factors a disease that is widespread and one which has been proved to be capable of affecting almost every tissue of the body?

Charles Nicolle, one of the most distinguished students of undulant fever, has made this prediction concerning the disease:

> Mediterranean fever is in the course of evolution, and is tending to become chronic. It is a malady which because of its manifestations and chronicity will become one of the commonest and most stubborn diseases. . . . Mediterranean fever is a disease of the future.

3720 Washington Avenue.

DISCUSSION

DR. ARTHUR J. BEDELL, Albany, N. Y.: Dr. Green has thoroughly covered the subject of the ocular evidence of undulant fever. I would, however, sound a note of warning, and that is not to ascribe all the ocular signs present in a patient who has undulant fever to that condition, until all others have been excluded.

To illustrate this, a man aged 39 had a trivial injury to his right eye. This was so slight that he paid no attention to it and did not see a physician. Four days later he covered his uninjured eye and found that he could not see from the injured one.

A photograph taken within a few days showed a white optic nerve. The macular region was dark, and surrounding the pale disk were concentric white rings, ruptures in the choroid. The vision was 10/200.

The patient's attorney introduced questionable evidence to the effect that the slight conjunctival injury caused a localization of the organisms of undulant fever in the back part of the eye. The man was awarded compensation for the loss of the vision of his right eye.

The point is that a patient may carry organisms of many kinds. I do not believe that there is justification for considering choroiditis the result of undulant fever simply because the patient has that infection. Undulant fever and its effect on the eyes are open to further investigation.

DR. ALBERT C. SNELL, Rochester N. Y.: I wish to report the case of an 8 year old child in whom central retinitis developed. Roentgenograms of the chest were normal, and cutaneous tests for tuberculosis gave negative results. In trying to find some cause for the condition, I found that undulant fever was present in a small, private dairy. The owners of the dairy maintained their own herd of five or six Jersey cattle, and the veterinarian proved that the herd was infected. The patient had some recurrent fever which resembled malaria, but there was no malaria in that particular part of the country, so that the diagnosis was made of brucellosis in the cattle and of undulant fever in the child. Typical retinitis was present for some time, with considerable elevation of the fundus around the macular region. The central vision was lost.

DR. EUGENE M. BLAKE, New Haven, Conn.: I wish to add 1 case to Dr. Green's series. The patient, a woman of 55 years, was seen in June 1936 at the New Haven Hospital. The onset of her illness occurred in February of the same year. Following the extraction of a tooth she had had frequent sore throats, and the cervical glands were tender and swollen. On April 24 she had a fairly severe chill. At the time of her entrance to the hospital the temperature was 103 F., the entire pharyngeal wall was red and the right wall was bulging.

Laboratory examination revealed 5,400,000 red blood cells and 9,300 white blood cells, with 60 per cent polymorphonuclear leukocytes, 27 per cent lymphocytes, 11 per cent large mononuclears and 1 per cent eosinophils. The culture from the throat yielded Streptococcus viridans (4 +), Pneumococcus (1 +), Haemophilus influenza (1 +) and Micrococcus catarrhalis (1 +). The cutaneous reaction for undulant fever was 4 +.

One transfusion of 500 cc. of citrated blood was given.

The patient remained in the hospital for seven weeks, and during the entire time there was a daily rise of temperature to over 100 F. She had been mildly diabetic for twenty years, and this condition was readily controlled by small doses of insulin and diet.

In 1934, while sojourning in Florida, the patient had what was diagnosed as a dendritic ulcer, which healed, leaving a small scar on the

right cornea. Soon after admission to the hospital, in 1936, the right eye became inflamed, and a small epithelial defect appeared at the upper margin. In spite of treatment, this increased until two thirds of the cornea stained with fluorescein. This gradually healed, but the cornea became deeply infiltrated and has remained so to date. There are anesthesia of the cornea and a yellowish white infiltration, which barely allows the pupil to be seen through it. There are deep and superficial vessels, and the condition in the cornea resembles severe interstitial keratitis more than anything else. In spite of the use of medicaments, such as ethylmorphine hydrochloride, yellow mercuric oxide ointment and heat, the condition remains unchanged. There is a secondary glaucoma, with tension of 36 mm. (Schiötz), which is fairly well controlled with a 1 per cent solution of pilocarpine hydrochloride.

It is, of course, entirely questionable whether the corneal disease is definitely related to the undulant fever or was simply a result of the streptococcic infection. However, the corneal picture is unusual and should be added to the conditions complicating undulant fever, along with those reported by Dr. Green, until a clearer understanding of the disease is obtained.

Dr. John Green, St. Louis: My primary purpose in writing this paper was to make ophthalmologists "brucellosis conscious." In St. Louis one of the large laboratories is making it a practice to carry out cutaneous tests on practically all patients who are sent in for Wassermann or tuberculin tests, and in that way this one laboratory has found 500 cases of infection with Brucella abortus within two years. It does seem as though there is a great difference in the prevalence of the disease in different parts of the country. In some of the great dairy states, such as Iowa and Michigan, more studies on undulant fever have been made than in other parts of the country, and in New York also there have been a number of excellent studies. On the basis of present knowledge it is impossible to be certain in many cases of undulant fever in which there are ocular lesions as to the causative relation to the organism, but with all other tests negative and the reaction of the test for brucellosis strongly positive, the relationship is suggestive.

The complication in the case reported by Dr. Blake is very rare. Judging from the literature, the cornea is about the least involved of all the ocular tissues.

MALIGNANT MELANOMA OF THE CHOROID WITH METASTASES

REPORT OF A CASE

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The comparatively rare condition reported here has been called melanosarcoma and is generally referred to in this manner in textbooks, but recently many authors have preferred to call it malignant melanoma, as there is some doubt as to its exact origin.

REPORT OF CASE

A stalwart man 26 years of age, of Portuguese parentage, who first consulted me on Aug. 16, 1935, gave a history of severe pain in the left eye of two weeks' duration. He had noted a gradual reduction of vision in the left eye several weeks prior to the onset of acute pain, and for several weeks before consulting me he had noticed from time to time a dull ache in the left eye. The patient said that he had not received any injury and could not connect the symptoms of the left eye with any accident or recent acute inflammation.

Examination revealed the vision of the right eye to be 20/20, while that of the left was reduced to the doubtful counting of fingers in the temporal field. The right eye was essentially normal in all particulars. The fundus was clear, and no evidence of a pathologic process was noted. The tension of the right eye was 20 mm. of mercury (McLean). The left eye, however, showed marked, deep, pericorneal injection; the cornea was quite steamy, and the anterior chamber was extremely cloudy and shallow. The tension of the left eye was 100 mm. of mercury (McLean). The iris could be seen with difficulty. The pupil was slightly dilated, and the picture in general resembled that of an acute inflammatory glaucoma. Details of the fundus could not be made out.

The patient was hospitalized, and conservative treatment was tried for three days without success.

On August 29 posterior sclerotomy of the left eyeball was performed between the superior rectus and the external rectus muscle and posterior to the ciliary body. There immediately presented in the wound a large herniating mass of dark red or black material which resembled clotted blood. The excess amount of this material was expressed and sent to the laboratory for microscopic examination. The laboratory report stated that the condition was a melanoma, and on August 31 the left eyeball was enucleated and sent to the laboratory. The pathologic examination showed a mass of friable, dark colored tissue nearly 1 cm. in thickness which appeared to have its origin in the choroid in the temporal portion of the eye. The pathologic diagnosis was melanosarcoma or malignant melanoma.

A thorough general physical examination, including urinalysis and a Wassermann test of the blood, revealed no evidence of any abnormality. The patient was an unusually well developed physical specimen. The socket appeared clear, and his recovery was uneventful so far as the enucleation was concerned. The

right eye was carefully studied with a slit lamp and the Gullstrand ophthalmoscope, and no evidence of a pathologic process could be found. The patient was kept under observation until December 1935, having received several doses of high voltage roentgen therapy to the left orbital region in the interim.

He was allowed to return to his home on one of the other islands with instructions to report at regular monthly intervals for further observation. This he failed to do, and he was not seen again until July 1936, when he returned complaining of being unable to keep the artificial eye in place owing to a swelling of the left orbital tissues. Examination revealed a large mass of tissue which could be seen through the transparent conjunctiva, herniating forward so that an artificial eye could not be kept between the lids. A small incision was made in the mass, and some of the tissue was sent to the laboratory, where a diagnosis of melanosarcoma was made.

After consultation, the patient permitted complete exenteration of the left orbit. This was done radically, electrocoagulation being used to control the bleeding points. Large doses of high voltage roentgen irradiation and radium were given, and recovery was uneventful. The orbit remained free from any recurrence of the growth. The patient was observed daily for dressings, and with the exception of some yellow serosanguineous discharge, the left orbit remained free from any recurrence of the disease until his death.

In March 1937 he was again admitted to the hospital for the purpose of repairing the left orbit by application of skin grafts, several pieces of skin being removed from the inner part of the arm and transplanted into the orbit, with successful results. With the exception of a small fistulous process in the nasal side over the lamina papyracea, the left orbit was satisfactorily epithelized. Ultimately, the orbit became clean and required nothing more than a light pad of gauze from day to day. The patient, however, began to complain of loss of weight and some vague abdominal pain, which he thought was due to dietary indiscretion. Metastasis was suspected, although up to this time no evidence of metastatic involvement had been found, in spite of careful observation. The patient was again referred to an internist, who thoroughly examined him and could find no evidence of a metastatic process. He continued to lose weight, and in June 1937 had lost a total of approximately 40 pounds (18 Kg.) during the preceding six months. Physical examination now showed some tenderness over the liver and slight enlargement below the costal margin. The hemoglobin content was 72 per cent at this time. The patient was given large doses of roentgen irradiation to the area of the liver but continued to complain more and more severely of abdominal pain. The liver continued to enlarge, and by August 8 it was enlarged 4 fingerbreadths below the costal margin. His condition seemed so hopeless that his family felt they would like to have him return to his home, which he was permitted to do. He died on Oct. 2, 1937.

HIGHER VISIBILITY IN A ROENTGENOGRAM ILLUMINATOR

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The usefulness of roentgen plates and films to the surgeon sustains a direct, and to the diagnostician in many cases perhaps a proportionate, relation to their visibility. Important factors in attaining a high degree of visibility are the brightness and color relationship of the background to the details to be discriminated, and the intensity of the illumination. With respect to the first of these factors, it may be noted that details neutral as to color are best seen on a clear white background. With respect to the second factor, it may be said that the amount of light needed to give the highest power to discriminate detail varies with the density of the film and with the person making the examination. Not all films or all parts of the same film are of the same density; and the intensity of light giving the highest visibility varies widely from person to person, depending on such factors as age, size of pupil, refractive condition of the eyes, susceptibility to glare, clearness of the media, the condition of the sensorium, etc. If too little light is used, low visibility occurs from insufficient stimulation of the retina; if too much is used, glare and harmful scatter of light are produced. From film to film there is variability in both absorption and scattering action. All these factors lower visibility and confuse the discrimination of detail.

In figures 1 and 2 is shown a roentgenogram illuminator which was devised to satisfy the foregoing requirements for high visibility. With it, the intensity of light may be varied in continuous series from zero to full without change in the color or composition of the light or in the size, shape or location of the illuminated area. This variation is accomplished also without any change in the position of the lamp.

The device for producing the variable illumination consists essentially of a reflecting housing, which may be of any size or shape desired, a rotatable shutter and a diffusing element to break up all shadows and give an evenly distributed and well diffused illumination. From this it can be seen that the construction can readily be adapted to any size or type of lamp and to cover any range of intensity that might be desired.

From the Research Laboratory of Physiological Optics.

The unit further consists of a flaring bonnet-like construction on the front of the housing. Across the opening of the housing just in front of the shutter is a plate of etched Whiterlite glass, which serves to give both color correction and in part the diffusion mentioned previously. Approximately 5 inches (13 cm.) in front of this glass and across the opening of the bonnet-like extension is a sheet of Celestialite glass, which serves to complete the diffusion and to give a transilluminated background against which the plate or film is viewed. So good is the diffusion thus afforded that no trace of shadow from the vanes

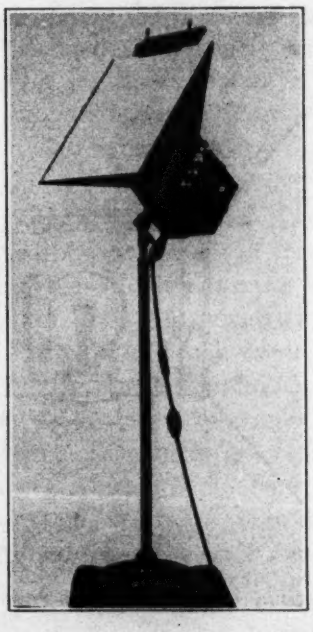

Fig. 1.—A roentgenogram illuminator with variable intensity of light, corrected for color.

can be seen on this glass. At the top of the extension a clip is added to hold the plate or film in position. For viewing plates or films of different sizes, masks are provided having differently sized apertures. Depending on the amount of color correction that is wanted, Whiterlite or Daylight glass may be used for the plate directly in front of the shutter. Our experience is that the better the color correction, the better the results. With the diffusion given with this setup and with sufficient color correction and the proper adjustment of intensity, a greatly improved visibility is obtained. Quite good results can be obtained, however, by making both plates of Celestialite glass. This

glass, it may be noted, affords both an excellent degree of diffusion and some color correction.[1]

The means for varying intensity consists of four vanes, which extend across the opening of the housing in such relation to each other that when their flat surfaces are parallel to the beam of light the maximum amount of light passes through the opening, and when they are rotated to a position at right angles to the beam the light changes in continuous series from full intensity to zero. In changing the intensity, the vanes are so actuated as to cause the contiguous vanes to turn in opposite directions. This insures an absence of shift in the position of the illuminated area and of change in its size and shape. When all the vanes move in the same direction, as is the case with Venetian blinds,

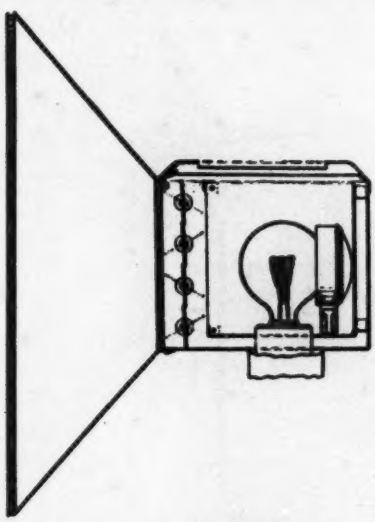

Fig. 2.—A vertical section of the roentgenogram illuminator, showing the shutter for varying the intensity of light.

all these changes take place. In the various models of the instrument different means of actuating the vanes have been employed. In the unit shown in figure 1, a pin or shank which passes through an opening to the outside of the housing is attached at the central point of each end of the vane. Mounted at the outer end of these pins on one side of the unit are cogwheels or gearings, 1½ inches (3.8 cm.) in diameter, which mesh with each other. On one of these cogwheels is a small knob for convenience in turning the vanes. In one of the latest models a simpler means has been devised which lies within the housing and is

1. Whiterlite glass and Daylight glass may be obtained from the Macbeth Daylighting Co., New York, and Celestialite glass from the Gleason-Tiebout Co., New York.

entirely free from slack or backlash. This is in the form of a thin plate with a central longitudinal slot, through which pass the axle pins at the ends of the vanes. This slot permits the plate to travel back and forth as the vanes turn. Above and below it in alternate sequence are short vertical slots which engage pins suitably positioned at the ends of the vanes. To the end of the axle of one of the vanes is attached a knob. When this knob is turned, the contiguous vanes rotate in opposite directions as is desired.

When there is need of varying the intensity of light, it is the tendency among manufacturers, for purely commercial reasons, to use a rheostat. There are many objections, however, to this means of varying the intensity of light, particularly in the present case. In fact, the mechanical means described here was devised to get away from these objectionable features. The correct use of a rheostat in relation to a source of light is, in conjunction with an ammeter or a voltmeter, to guard against variations in the intensity of light, not to produce them.

Several years of hospital experience has led us to believe that high visibility in roentgenograms is greatly prized by surgeons and diagnosticians and that even small improvements in this direction merit serious consideration. We would especially emphasize here the need of having just the right amount of light on the roentgenogram and the impossibility of getting this amount for different roentgenograms and different parts of the same roentgenogram unless the change of intensity can be accomplished in continuous series. This could not very well be done, for example, with a rheostat. The difference between the most favorable intensity and the intensity which gives either simple or veiling glare or both is in some cases and for some persons quite small. In this connection we would call to mind the wide range of variation there is for different persons in the amount of light that is most favorable for the discrimination of details and in the difference between this amount and the threshold of glare. In both of these respects age is a most important factor. In general, in the adaptation of intensity to the needs of the individual the difference in the requirements of those under and those above 40 years of age is in many cases astonishingly great. Differences in the scattering action of the film also create a need for a means of varying intensity of light in continuous series or by small steps.

We would further strongly emphasize that the change of intensity should not add color to the background against which the details of the roentgenogram must be viewed. Both the film and the light are already too colored. Details neutral as to color cannot, all must agree, be seen clearly against a colored background, particularly when that color is produced by transillumination. The use of a rheostat, for example,

would normally mean that the lamp would be run at a reduced voltage, which would cause a change in color toward the long wavelengths. This change of color might in some cases offset almost if not entirely the benefit obtained from change of intensity. The transmitted light is already too yellow. Its further change toward orange by the use of a rheostat is bad indeed. In addition, change in the composition of light changes the amount of scatter given to the light in passing through the film. The long wavelengths are scattered more than the short.

In any attempt to improve the visibility of details in the roentgenogram, color correction of the light is vastly important as an initial step. The ideal condition is to start with light of daylight quality and to vary the intensity by just the right amount to give highest possible visibility without changing the color and composition of the light. The full effect of the benefit so obtained must be experienced to be believed. In our opinion no surgeon or diagnostician who has had the opportunity of experiencing these benefits would fail to commend them or hesitate to incur the additional expense of obtaining them, if indeed any considerable additional expense is required. The expense of the device for varying intensity is, we may say, slight in the simplified form. In any event, where human welfare, even human life, are at stake, small differences in cost are in comparison of little consequence. Our motive for devising this improvement has been the experience of an important need.

The model shown in figure 1 was not made to suit any particular situation. It was constructed solely for the purpose of trying out the improvement in visibility. But even in the form shown, it might perhaps be convenient for use in an operating room where the surgeon needs to look at the film while the operation is in progress. The device as described can be readily adapted to any type of stand or cabinet for the examination and study of roentgenograms.

Made after a suitable design, the equipment serves an excellent purpose also for viewing dental films and lantern slides. For the equipment in small sizes, a single rotatable vane would suffice for the control of intensity. Properly designed, we believe that this equipment in its various forms would render a great and much needed service to many persons. In suitable designs and sizes, a magnifying element can also be used, either mounted on the instrument or held in the hand. In addition to its service for viewing roentgenograms, we have personally derived great satisfaction from using the unit in conjunction with a magnifier for studying lantern slides in preparation for lectures and other purposes. Because of the grain of the film, there is, of course, a limitation to the magnification that can be used to advantage. In a magnifying system it may also be noted that a means of varying intensity to suit the degree of magnification is an advantage.

SUMMARY

Important factors in attaining high visibility in roentgen plates and films are the brightness and color relationship of the background to the details to be discriminated and the intensity of illumination. Details neutral as to color are best seen on a clear white background. The amount of light needed to give highest power to discriminate detail varies with the density of the film and the person making the examination. Not all films or all parts of the same film are of the same density; and the intensity of light giving the highest visibility varies widely from person to person, depending on age, size of pupil, refractive condition of the eyes, susceptibility to glare, clearness of the media of the eyes, condition of the sensorium, etc. If too little light is used, low visibility occurs from insufficient stimulation of the retina; if too much is used, glare and harmful scatter of light are produced. A roentgenogram illuminator is described which was devised to satisfy the foregoing requirements for high visibility. By means of a rotatable shutter, the contiguous vanes of which turn in opposite directions, the intensity of light may be varied in continuous series from zero to full and without change in the color or composition of the light. Neither of these important requirements can be satisfied when, e. g., a rheostat is used to vary the intensity. Color correction and high degree of diffusion are secured by filtering the light first through etched Macbeth daylight or Whiterlite glass and second through Celestialite glass. The construction can readily be adapted to any type of stand or cabinet.

VASCULAR OBLITERATION FOR VARIOUS TYPES OF KERATITIS

ITS SIGNIFICANCE REGARDING NUTRITION OF CORNEAL EPITHELIUM

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Two of the existing concepts of the function of blood vessels in corneal tissues are diametrically opposed. According to the first, the one generally held, the function of the vessels is reparative; according to the second, it is destructive. Growth of blood vessels regularly accompanies healing throughout the body; repair and vascularization go hand in hand in practically all inflammatory processes. A well marked interstitial keratitis rarely shows any regression until from four to eight weeks after the onset, at the time when stromal vessels become visible. The same is true of many other corneal inflammations. For instance, some deep herpetic infections fail to subside for many weeks or even months. During this period of time blood vessels have made their appearance in the corneal stroma, and when healing does occur it is likely to be attributed to the increased vascularity. On the other hand, the clinical course of a fascicular ulcer, "wandering phlyctenule," indicates that the blood vessels actually cause the tissue necrosis and thus activate the ulceration. In this disease one finds slowly creeping across a cornea an ulcer apparently driven by a leash of blood vessels close at its heel. Hence it must be assumed either that corneal vessels have diametrically opposite functions under different conditions or that the interpretation of the function of the blood vessels is at fault in one or the other concept.

Wounds may heal by primary intention with little assistance by blood vessels, as is illustrated in corneal grafting. A full thickness graft usually adheres perfectly and grows solidly into position before any vessels make their appearance. It is clear that vessels are of no assistance in this type of healing; in fact, the postoperative ingrowth of blood vessels is the greatest hazard in keratoplastic operations. The concept that well vascularized organs are less subject to infections than those with a poor blood supply is not borne out in the eye. The

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Read before the Section on Ophthalmology at the Eighty-Ninth Annual Session of the American Medical Association, San Francisco, June 17, 1938.

avascular cornea rarely becomes infected after trauma or during the course of an acute conjunctivitis which represents a severe infection of an adjacent well vascularized tissue. The lens, which is remotely dependent on blood supply for nutrition, if uninjured practically never becomes infected, and similarly the vitreous is very resistant, since prolapses of this tissue into operative wounds remain free from infection even when persisting for many weeks.

The observation that reducing the supply of blood has a healing effect on corneal lesions was first made almost two centuries ago. The use of astringents or of surgical treatment to effect this result was advocated then more universally and with greater clarity than it is today.

Boury,[1] as early as 1743, advised cutting the vessels all around the cornea. He called his operation ophthalmophlebotomy. De Saint Yves [2] (1767) used a similar procedure.

Antonio Scarpa [3] (1801), one of the most astute observers of his day, wrote as follows:

> The treatment that is indicated for a nubecula of the cornea consists in shrinking the varicose vessels of the conjunctiva down to their natural caliber or, if this cannot be accomplished, in severing the trunks of the more prominent varicose vessels of the conjunctiva from their slender roots at the point where the latter leave the external surface of the cornea in the region of the nubecula. The former method of treatment is carried out by means of local astringents and corroborants mentioned in the preceding chapter, first place being given to the ophthalmic ointment of Janin [4]; these remedies suffice provided the nubecula is in its early stage of limited extent. But when it has advanced near the center of the cornea and the relaxation of the conjunctiva and its vessels is considerable, the most effective and quick-acting expedient of all those hitherto proposed is recision of the bundle of varicose veins near its roots, that is, in proximity to the nubecula of the cornea. By means of such recision the blood that has slowed

1. Boury, J. W.: Dissertatio de maculis corneae earumque operatione chirurgica, apotripsi, Lausanne, 1743.

2. de Saint Yves, C.: Nouveau traité des maladies des yeux, Amsterdam, Arkstée & Merkus, 1767, pp. 171 and 178.

3. Scarpa, A.: Saggio di osservazioni e d'esperienze sulle principali malattie degli occhi, ed. 1, Pavia, Baldassare Comino, 1801, p. 106.

4. The ophthalmic ointment of Janin consists of melted hog fat, 1 ounce (31 Gm.); prepared zinc oxide, 2 drachms (7.7 Gm.); Armenian bole, 2 drachms (7.7 Gm.), and ammoniated mercury, 1 drachm (3.8 Gm.). The hog fat must first be washed three times in rose water. The drugs are to be mixed in a glass mortar. The preparation is imperfect and of little value unless the ingredients have been reduced to an impalpable powder. Janin wrote (1772) that this is an excellent ophthalmic remedy, not only for inflammation but for emptying varicose veins and restoring them to their natural state. It dissipates (corneal) maculas, reduces engorgement of the lids, cleanses and cicatrizes ulceration of the margins of the lids and of the cornea. Armenian bole is a compact, soft, unctuous clay from Armenia. It contains ferric oxide and has astringent properties.

up in the roots of the dilated veins on the surface of the cornea is at once drawn off, and the varicose vessels of the conjunctiva more readily regain their normal tone and caliber; at the limbus is formed a kind of filter for the egress of whatever serum or other albuminous material has spread in the tissue of the thin lamina of conjunctiva overlying the cornea or in the cellular tissue that binds together these two membranes. It is really surprising how quickly a nubecula of the cornea is dissipated by means of this operation, for in the majority of cases the lapse of twenty-four hours after the recision of the bundle of varicose vessels of the conjunctiva is sufficient to cause the disappearance of the opacity at the site of the nubecula.

Charles Bell [5] in 1816 stated:

The practice is to extirpate the tortuous fasciculus of vessels, whose elongation over the cornea *caused*, or necessarily accompanied the formation of the opacity, and which we may now suppose feeds and supports it.

Toward the middle of the nineteenth century the *Ophthalmic Hospital Reports* published articles by Bader [6] on syndectomy and by Lawson [7] on peritomy. Bader reported the results of operation in 24 cases of vascularized cornea with or without granular lids. Some of his results were truly remarkable. He concluded: "Syndectomy is a less dangerous and troublesome mode of treatment than that by inoculation of pus." Lawson was not greatly impressed by his results but concluded that in milder forms of vascularized cornea, when inoculation with pus could not be judiciously advised, peritomy might be of benefit.

Furnari,[8] of Paris, while working in Algiers, first performed the operation of peridectomy for trachoma as early as 1842 but did not publish his results until 1862. Although his own results were excellent, the operation was found too radical by other surgeons, and their bad results served to relegate the procedure to oblivion for the rest of that century.

In the present century the operation of syndectomy was revived and modified by Denig.[9] Rather than allow the bulbar conjunctiva to replace itself over the excised area, buccal mucous membrane was grafted on the exposed sclera. This foreign mucosa was said to retard the downgrowth of vessels onto the cornea and to be resistant to trachomatous infection. Seefelder,[10] Friedman [11] and Kaminski [12] have since demonstrated that the graft does become infected if put on during the acute

5. Bell, C.: Operative Surgery, ed. 2, Hartford, Hale & Hosmer, 1816, vol. 2, p. 90.
6. Bader, C.: Ophth. Hosp. Rep. **4**:19, 1863-1865.
7. Lawson, G.: Ophth. Hosp. Rep. **4**:64, 1863-1865.
8. Furnari, S.: Gaz. méd. de Paris **17**:54, 83, 114, 147, 176 and 210, 1862.
9. Denig, R.: Ztschr. f. Augenh. **25**:278, 1911.
10. Seefelder, R.: Klin. Monatsbl. f. Augenh. **81**:68, 1928.
11. Friedman, B.: Rationale of Denig Transplant in Trachoma, with Microscopy of Graft in Two Cases, Arch. Ophth. **4**:868 (Dec.) 1930.
12. Kaminski, D. S.: Klin. Monatsbl. f. Augenh. **87**:60, 1931.

stage. Friedman furthermore stated that the vascularity of pannus is apparently not altered by the removal of the limbal conjunctiva or its replacement by a graft.

Weller,[13] Teale,[14] Ziegler,[15] Fox,[16] Whitehead,[17] Gallewaertz,[18] D'Amico,[19] Alonso [20] and others have written enthusiastic reports about peritomy.

Szokolik [21] reported good results after peridectomy in 12 cases of pannus. He found no need for the transplantation of buccal mucosa and suggested that the deep blood supply was all that was necessary for corneal nutrition. Whitehead advocated peritomy especially for some forms of corneal tuberculosis.

Most textbooks fail to discuss the pathogenesis of wandering corneal ulcers. Their writers are aware that fascicular ulcers occur but rarely attempt an explanation of this curious disease.

D'Amico suggested an explanation for the beneficial effect of partial peritomy in cases of trachomatous pannus by assuming that the uncut blood vessels underwent compensating dilatation, thereby enhancing nutrition and carrying away toxins. To me, this explanation seems inconsistent.

In "Das Kurzes Handbuch der Ophthalmologie" (Schieck and Brückner) [22] the most modern concept of the etiology of "wandering phlyctenules" is explained as follows:

> An explanation for this peculiar condition is possible if we assume that the blood vessels in these cases carry tuberculous antigens. Then the newly formed vessels do not bring about the desired healing but an anaphylactic inflammation in the sensitized cornea, which causes the ulcer to continue unabated. This argument is strengthened by the observation that in certain cases when the vessels are divided at the limbus the inflammation subsides. Just as welcome as a pannus is in scrofulus keratitis, just so destructive are the vessels in "Gefassbandchen."

This allergic reaction may occur in patients with phlyctenular keratitis who are very sensitive to tuberculin, but it seems unreasonable to assume

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13. Weller, C.: Die Krankheiten des menschlichen Auges, Berlin, Schüppel, 1826, p. 208.
14. Teale, T. P.: Tr. Ophth. Soc. U. Kingdom **21**:146, 1901.
15. Ziegler, S. L.: The Surgery of Trachoma, J. A. M. A. **30**:131 (Jan. 15) 1898.
16. Fox, L. W.: Ann. Ophth. **12**:614, 1903.
17. Whitehead, A. L.: Brit. J. Ophth. **6**:529, 1922.
18. Gallewaertz, M.: Ann. d'ocul. **160**:342, 1923.
19. D'Amico, D.: Cong. Soc. ital. d'opht. **10**:22, 1930.
20. Alonso, A. F.: La peritomia en las ulceras cronicas vasculares de la cornea, Internat. Cong. Ophth. **1**:371, 1922.
21. Szokolik, E.: Klin. Monatsbl. f. Augenh. **78**:693, 1927.
22. Schieck, F., and Brückner, A.: Kurzes Handbuch der Ophthalmologie, Berlin, Julius Springer, 1931, vol. 4.

that it is always tuberculous antigen that causes a "wandering ulcer" at the site of dendritic keratitis (cases 1 and 2) or an ulcer in the vascularized scar of an old corneal laceration (case 24). In the majority of cases it would seem that it is some noxious substance other than tuberculous antigen that is brought in by the blood vessels.

Where does the cornea get its nutrition? The generally accepted notion given in textbooks is that nutriments enter by a process of diffusion from the pericorneal blood vessels, but that they may also enter from the aqueous. Apparently this view is based on the experiments of La Queur [23] (1872) and Gruber [24] (1894), who after producing rust spots in the corneas of cats and injecting potassium ferrocyanide into the circulation noted that the spots became blue from the peripheries toward the centers of the corneas. The same effects were noted after injecting ferrocyanide into the anterior chambers. The cornea seems to be able to live and remain transparent when either source of nourishment alone is cut off, as illustrated by Gruber in doing complete peritomy and by Coccius [25] (1852) in keeping the anterior chamber filled with air. The cornea is said to have an exceedingly "slow metabolism" (Duke-Elder [26]) which enables it to be satisfied with nourishment from either the aqueous or the pericorneal vessels. There are no direct measurements to support the contention that its metabolism is slow. On the contrary, Bessey [27] is finding that excised corneas of rats show an astonishingly fast metabolic rate. Working with a Warburg respirator, which measures accurately the oxygen consumption of tissues, he found that the entire cornea per milligram of dry weight utilizes about 4 cu. mm. of oxygen per hour, i. e., four-sevenths as much as liver tissue and four-sixths as much as muscle tissue, which have rapid respiratory rates, and four times as much as cartilage. In view of the fact that the bulk of the entire cornea consists of its stroma, a tissue somewhat like cartilage, the high respiratory rate of cornea found by Bessey points toward a rapid respiration of the epithelium itself. The most active portion of the cornea certainly is the epithelium. Its tremendous regenerative power is known from clinical experience. No wounds heal as rapidly as do those of the corneal epithelium. The epithelium may regenerate over the entire surface of the cornea in three or four days.[28]

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23. Laqueur, L.: Centralbl. f. d. med. Wissensch. **10**:577, 1872.

24. Gruber, R.: Arch. f. Ophth. **40**:25, 1894.

25. Coccius, E. A.: Ueber die Ernährungsweise der Hornhaut und die Serumführnden Gefässe im menschlichen Körper, Leipzig, I. Müller, 1852.

26. Duke-Elder, W. S.: Textbook of Ophthalmology, St. Louis, C. V. Mosby Company, 1933, vol. 1.

27. Bessey, O. A.: Personal communication to the author.

28. Gundersen, T.: Herpes Corneae with Special Reference to Its Treatment with Strong Solution of Iodine, Arch. Ophth. **15**:225 (Feb.) 1936.

Surely an active tissue like corneal epithelium must require a ready source of nourishment as well as oxygen. It is not yet possible to say with certainty whence they come. The oxygen necessary to support corneal respiration is readily available if the cornea can utilize the surrounding atmosphere. The cornea of an excised eye placed in an atmosphere saturated with moisture will remain transparent for twenty-four hours, but if the air is replaced by hydrogen, the cornea rapidly becomes opaque (Bullot,[29] 1904). Fisher [30] (1930) has shown that oxygen can pass only from the epithelium toward the anterior chamber and carbon dioxide only in the reverse way.

To determine if corneal tissue could live in aqueous alone, I devised the following experiment: A full thickness piece of cornea was removed from the eye of an animal and transferred to the anterior chamber of the opposite eye. This experiment was carried out on 17 cats and 10 rabbits. Trephine disks 3.5 mm. in diameter were implanted in the eyes of 24 animals, and strips of cornea 3 by 10 mm. were implanted in the eyes of 3 animals. In all except 1 instance the implants adhered to the iris and became vascularized. In the 1 instance in which this complication did not occur, the implant was free in the aqueous at all times, and it remained so for twenty months without ever becoming adherent to the iris. Thus it was possible to observe the changes which occurred in corneal tissue surrounded by normal aqueous alone. The corneal disk remained relatively transparent for about six months and diminished little if any in size. It then became semi-opaque and globular and remained so without any visible change for the remaining fourteen months. The eye was then removed and the disk studied histologically in serial sections. The epithelium had entirely disappeared. The stroma showed no necrosis, hyalinization or fibrosis, while the endothelium had proliferated and surrounded the entire piece. It is noteworthy that even in the other experiments, though the implants became vascularized through their adhesions to the iris or cornea, the epithelium was found absent on microscopic examination. The details of this experiment have been reported elsewhere.[31]

This direct experiment shows that the stroma and "endothelium" can live for a prolonged period in aqueous alone but that the epithelium cannot.

On first thought; this statement may seem to conflict with the fact that epithelium can grow in the anterior chamber, as in the condition "epithelization of the anterior chamber" following perforating wounds

29. Bullot, G.: J. Physiol. **31**:359, 1904.

30. Fisher, F. P.: Arch. f. Augenh. **102**:146, 1930.

31. Gundersen, T.: Results of Autotransplantation of the Cornea into the Anterior Chamber: Their Significance Regarding Corneal Nutrition, Tr. Am. Ophth. Soc., 1938, to be published.

and especially after operations for cataract. But in this condition the epithelium is not free in the aqueous but is supported by a vascularized framework which probably supplies its nutrition. Again, in epithelial cysts of the anterior chamber the conditions are not analogous to those of my experiment—the cysts contain serum.

It seems likely that the corneal stroma and endothelium can exist on metabolites derived from aqueous alone but unlikely that the epithelium can or does. Its requirements are too high. If the corneal epithelium cannot live in the aqueous humor and if its supply of nourishment from the blood can be almost completely destroyed by peritomy without affecting its existence, then the tears fall under direct suspicion as the nutritive vehicle. The sugar content of tears has not been exhaustively studied, but according to the analyses of Brown [32] it is exceedingly high, 0.65 mg. per hundred cubic centimeters, or approximately six times that of the normal blood sugar.[33]

TABLE 1.—*Nitrogen and Sugar in Aqueous and Tears*

Aqueous (Duke-Elder)	Gm. per 100 Cc.	Tears (Ridley and Brown)	Gm. per 100 Cc.
Total protein nitrogen	0.0236	Total nitrogen	0.158
		Nonprotein nitrogen	0.061
Sugar	0.0083	Sugar	0.650

The following 36 cases show what effect destroying the abnormal blood supply has on the healing of corneal lesions. If direct blood supply were the most important factor in the maintenance of corneal integrity, one certainly would expect that corneal ulcers as well as other inflammatory processes in the cornea would be made worse by destroying this factor. The cases reported comprise a consecutive but carefully selected group of cases of various types of chronic keratitis in which the condition did not yield to customary methods of treatment. On each patient some form of peritomy was done, and the effect of the operation on the corneal lesion was carefully noted. The first patients were treated six years ago, the majority over four years ago and only one within the past year. Thus it has been possible to follow the late results.

The operative procedure was chosen to satisfy the requirements in each case. Neither complete peridectomy (syndectomy), as first suggested by Furnari (1862), involving the excision of a wide band of conjunctiva around the limbus, or Denig's modification, the transplanting of buccal mucous membrane, was employed.

32. Brown, cited by Ridley, F.: Brit. J. Exper. Path. **11**:217, 1930.

33. In a preliminary examination of the sugar content of tears, I have been unable to confirm these findings.

A careful preoperative study with the slit lamp is imperative. Each vascular trunk should be noted and its exact location at the limbus and its depth in the corneal stroma drawn on a schema. Particular attention should be directed toward the location of the arteries, since the obliteration of these is more difficult than that of the large veins. The latter are more obvious and usually more superficially situated in the cornea. If blood vessels are incised but not thoroughly coagulated, corneal hematomas develop quickly. Although they were not found to be injurious, they are disfiguring and absorb slowly. In case 1 (A. R.) and case 2 (J. P.) hematomas were found developing promptly after operation, but their progress was stopped immediately by locating with the slit lamp the large "feeding arteriole" and obliterating it with the diathermy needle.

The combination of diathermic cutting and coagulating current produced by a standard unit served the purpose efficiently, with less trauma and probably with a more discouraging effect on regeneration of the vessels than other cutting instruments. Individual vessels or groups of vessels were severed where they crossed the limbus by a few cutting strokes with a sharp-pointed needle, the point of which was carried as deeply into the stroma as was necessary. In several instances the conjunctiva was dissected from the limbus and the underlying sclera in order to make possible the coagulation of the reticular supply. The importance of the latter has been duly emphasized by Jameson.[34] This procedure was of value when the corneal vessels were at the level of Descemet's membrane. When vessels are at this level, direct attack at the limbus might be hazardous and attended by perforation of the anterior chamber, although this accident has never occurred in my experience. More postoperative reaction occurs in the eye when the reticular supply is disturbed after conjunctival dissection than when a purely local attack is made at the limbus with the diathermy needle. Transitory hypotony was observed in a few cases, corroborating Jameson's observations; transient wrinkling of the posterior corneal surface was observed in others.

Postoperative care was not considered particularly important. Patients were not hospitalized unless an extensive operation was done, since ordinarily but little ocular discomfort followed operation. A monocular bandage was applied under dark glasses for a few days until the wound was covered by new epithelium. Mildly antiseptic collyria were used at intervals of four hours (0.1 per cent zinc sulfate in a

34. Jameson, P. C.: Vascularization of the Anterior Segment of the Eye: The Bearing of These Studies on Some Operative Procedures, Including the Possible Supplementary Procedure for Glaucoma; Preliminary Report, Arch. Ophth. **9**:523 (April) 1933.

saturated solution of boric acid has been found satisfactory), and if secondary iritis existed, an appropriate mydriatic was used.

The following 36 consecutive cases are grouped as follows:

Group 1 consists of 6 cases in which ulcers developed associated with corneal vascularization following herpes corneae—keratitis metaherpetica. In these cases, as in those previously reported by me,[31] herpes virus could not be demonstrated in the ulcers.

Group 2 consists of 7 cases in which the etiologic factor was not clear, but the patients were thought to have ocular rosacea.

Group 3 consists of 12 cases of primary superficial keratitis, probably tuberculous in origin (chronic phlyctenulosis?).

Group 4 is composed of 2 cases in which keratitis followed injuries.

Group 5 consists of 2 cases of progressive yellow stromal infiltration (lipin interstitial keratitis). The etiologic factor in these cases was not clear, although at the onset it was considered tuberculosis.

Group 6 is composed of 5 cases of advanced trachoma.

Group 7 consists of a case of indolent hypopyon ulcer.

Group 8 consists of a case of ulcer of unknown origin, which would not fit into any of the preceding groups.

GROUP 1: DENDRITIC KERATITIS (KERATITIS METAHERPETICA)

CASE 1.—A. R., a man aged 42, was first seen on July 1, 1932, with an initial attack of dendritic keratitis of six days' duration. The cornea stained with fluorescein, as shown in figure 1 *A*. There were no corneal scars. Inoculation of a rabbit gave positive results. Epithelium was removed with an iodized toothpick swab on July 5. Six days later the eye was white and quiet and did not stain. On December 2 there was a minimal recurrence, the ulcer measuring 1 by 1 mm. (fig. 1 *B*). There was no congestion. Inoculations of a rabbit (two attempts) gave negative results. The ulcer healed five weeks after the onset, conservative treatment only being given. On March 14, 1933, there was a second recurrence, the ulcer measuring 1 by 2 mm. There was lacrimation but no congestion. Inoculations of a rabbit (two attempts) gave negative results. Superficial blood vessels were seen in the cornea. No improvement occurred following the usual treatment for ulcers, and a second smaller ulcer developed seven weeks after the onset. Vision was reduced to 20/40. General physical examination gave negative results except for a mild chronic eczema which had been present for ten years. During 1926 the patient had been treated successfully in the outpatient department of the Massachusetts General Hospital for mild prostatitis. He had had no recurrence of this condition. No other focal infection could be found. On May 5, 1933, vascularized ulcers (fig. 1 *C*) developed. By means of the diathermy needle the blood vessels were obliterated at the limbus (fig. 1 *D*). With the slit lamp it was then noticed that there was free blood outside the corneal vessels. There was no venous circulation, but near the limbus along the lower border of the fasciculus of vessels a single arteriole was seen with each pulsation to extravasate blood into the stroma. It became obvious that a large hematoma would develop in the corneal substance. This feeding arteriole was then coagulated, and there was no further escape of blood into

the tissue. Subsequently the patient made daily visits to the outpatient department, where sketches of the eye were made whenever there was any obvious change. The cauterized area was completely reepithelized in five days; there was no corneal staining after eleven days. Red blood corpuscles were present in the hematoma for fifty days. A few blood vessels had budded and crossed the limbus for a distance of 2.5 mm., but not until the ulcer had healed and the hematoma had been practically absorbed.

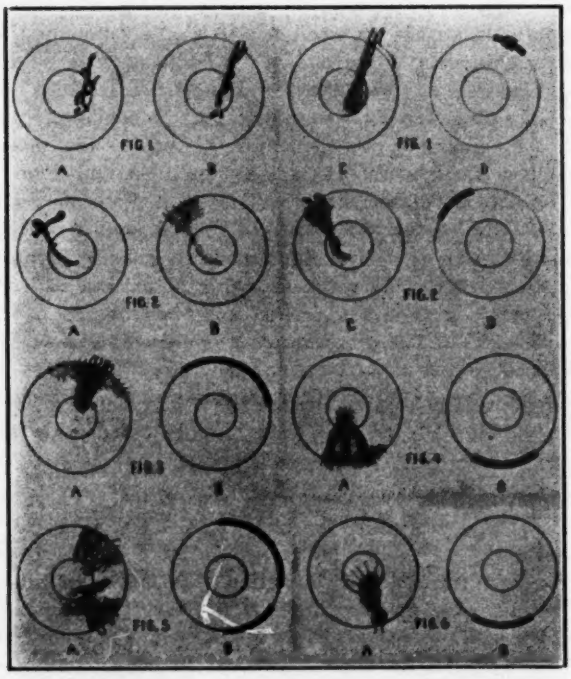
CASE 2.—J. P., a woman aged 72, was first seen on March 20, 1933, with an initial attack of dendritic keratitis of six days' duration (fig. 2*A*). She would not give permission for iodization. She was advised to use antiseptics, mydriatics and fomentations. Vision was 20/70. On March 24 inoculation of a rabbit gave positive results. On April 11 general improvement was noted. The staining area was reduced to a single spot 1 mm. in diameter and there was only faint congestion. Early vascularization occurred (fig. 2*B*). Examination on April 27 did not reveal any symptomatic improvement. The ulcer was slightly larger and nearer the pupillary space. The vascularization increased. There were many superficial vessels and a few in the midstroma. Inoculation of a rabbit gave negative results. Examination on September 6 showed the ulcer in the upper part of the pupillary space, with capillary loops on its limbal margin (fig. 2*C*). On September 7 the blood vessels were obliterated at the limbus with a diathermy needle (fig. 2*D*). The corneal tissue was incised to approximately one-third its depth. Examination with the slit lamp afterward showed complete hemostasis. Examination on September 8 showed that a thin hematoma had developed in the scarred area. Several folds in the corneal endothelium and a few cells in the aqueous were visible. The site of operation reepithelized in five days. The ulcer gradually diminished in size and ceased staining thirty-two days after operation. The visual acuity returned to 20/30. There have been no recurrences. A few small blood vessels have grown into the old scar.

CASE 3.—M. McH., a woman aged 32, had her first attack of keratitis, probably dendritic, in November 1933, following pneumonia. There was subsequent blurring of vision. She was first seen on Feb. 7, 1934. The eye had been constantly inflamed for the preceding eight weeks. There was a typical metaherpetic ulcer, 1 by 2 mm., with marked vascularization (fig. 3*A*). Inoculation of a rabbit gave negative results. Vision was 20/50. On February 8 vascular obliteration with a diathermy needle was carried out (fig. 3*B*). On February 12 the ulcer no longer stained with fluorescein. There was marked symptomatic improvement. On March 7 there was a recurrence of a single point of stain in the same area. On March 15 the ulcer continued to stain. There was some revascularization of old channels through a deep blood supply which had not been interrupted by the first operation. The deep vessels were obliterated. On March 19 there was no corneal staining. Vision was 20/20. In a follow-up letter in August 1935 the patient stated that there had been no recurrence of symptoms.

CASE 4.—A. R., a man aged 24 (a patient of Dr. W. L. Curran), was first seen on March 8, 1935. A foreign body had been removed from the left cornea two years previously followed by an uneventful convalescence. Four months previously a typical dendritic keratitis developed in the left eye, which was treated with tincture of iodine seven days after the onset. After a short period of complete reepithelization of the cornea, keratitis metaherpetica developed, and a small corneal ulcer had been present ever since. Several applications of iodine to the ulcer had failed to effect a cure. The eye showed faint congestion and a

TABLE 2.—*Summary of Cases of Dendritic Keratitis—Keratitis Metaherpetica (Group 1)*

No. of Case	Summary	Result
1	Ulcer of 7 weeks' duration; arrested in 11 days; no recurrence	Excellent
2	Ulcer of 25 weeks' duration; arrested in 32 days; no recurrence	Good
3	Ulcer of 10 weeks' duration; arrested in 39 days (2 operations); no recurrence	Good
4	Ulcer of 16 weeks' duration; arrested in 4 days; dendritic keratitis 1 year later	Excellent
5	Ulcer of 10 weeks' duration; arrested in 4 days; no recurrence	Excellent
6	Ulcer of 1½ weeks' duration; arrested in 4 days; no recurrence	Excellent



Figs. 1–6.—Diagrams illustrating cases of dendritic keratitis.

staining ulcer, 1 by 2 mm., in the lower part of the pupillary space. According to Dr. Curran's report, the ulcer had migrated from a position near the lower limbus to the position shown in figure 4*A*. There was superficial scarring in the lower part of the cornea. Many superficial and a few deep blood vessels entered the area. The visual acuity was reduced to 20/40. Obliteration of the pericorneal blood vessels was performed from 4:30 to 7:30 o'clock, local anesthesia being used. The diathermy needle was carried well into the corneal stroma at the limbus in the region of the deep blood vessels (fig. 4*B*). Examination with the slit lamp after the operation showed complete hemostasis. On March 22 Dr. Curran reported that the eye showed rapid improvement after operation. The ulcer ceased staining in four days, and the eye was practically

white in ten days. On March 15, 1936, the patient was seen again, having been well until two months before, when a second attack of dendritic keratitis developed. This was successfuly treated by the application of iodine.

CASE 5.—M. P. D., a girl aged 6 years, was first seen on Sept. 20, 1934. The child had had three previous attacks of inflammation of the left eye, presumably dendritic keratitis. The present attack was of ten weeks' duration and the symptoms did not abate. The left eye showed slight to moderate congestion, marked infiltration, old scarring and vascularization (chiefly superficial). The ulcer stained (fig. 5*A*). Inoculation of a rabbit gave negative results. The Wassermann reaction of the blood was negative. On September 22 the superficial vessels at the limbus were obliterated with the diathermy needle (fig. 5*B*). The ulcer ceased staining four days after operation. The patient remained in the Massachusetts Eye and Ear Infirmary for one week. The eye was white and quiet before discharge and remained so for the following two weeks. The patient has not been seen since.

CASE 6.—H. E. W., a woman aged 71, was first seen on May 7, 1937. The left eye had been moderately sore and red for three days. A previous attack in this eye two years before lasted three months. There was a corneal ulcer 2 by 1 mm. in size in the lower outer part of the pupillary space, with a prominent fasciculus of blood vessels extending to its edge. There were considerable scarring and infiltration surrounding the ulcer and a few folds in the posterior corneal surface but no cells in the aqueous and no keratitis punctata (fig. 6*A*). Marked corneal hypesthesia was present.

No improvement followed seven days of treatment with a bandage, atropine and mild antiseptics. Obliteration of the superficial pericorneal vessels was performed on May 14 (fig. 6*B*). On May 18 the ulcer no longer stained, and on May 28 there was no congestion. There has been no recurrence. The orignal attack was probably herpes corneae.

GROUP 2: OCULAR ROSACEA

CASE 7.—M. F. M., a man aged 64, was first seen on May 22, 1934. He gave a history of recurring attacks of inflammation in the right eye for fourteen years. He had been seen in the ophthalmic clinic at intervals for ten years. The present attack was of six months' duration. The eye was moderately congested, and in the lower part of the pupillary space there had developed a nodular, nonstaining corneal lesion surrounded by infiltrates and scars (fig. 7*A*). There was marked vascularization in all corneal layers, particularly in the deep stroma. There were no cells in the aqueous and no keratitis punctata. The visual acuity was 20/20. There was marked facial rosacea. The intradermal reaction to 0.1 mg. of old tuberculin was negative. On May 23 corneal blood vessels were incised at the limbus with a diathermy needle (fig. 7*B*). The incision was carried into the depths of the stroma, probably through two thirds of its thickness, and all the vessels except those on Descemet's membrane were interrupted. Little reaction followed the operation, but a small hematoma developed in the cornea, with some keratitis striata, which extended upward into the pupillary space. On June 8 the patient was asymptomatic, and the eye showed no congestion. On July 2 a slight recurrence of symptoms was noted, which had had its onset twelve days previously, with the formation of a new small corneal infiltrate near the limbus at 8 o'clock. By July 7 the recurrence had subsided completely. The report of Dec. 10, 1935, stated that the patient had been practically well since his last attack. The eye

was occasionally slightly irritable, but attacks were of only one or two days' duration. The cornea showed no new scars. The visual acuity was 20/20.

CASE 8.—M. R., a woman aged 72, was first seen on April 29, 1935. Both eyes had been constantly irritated for six years. The right eye showed slight congestion. There were marked keratitis epithelialis disseminata, with thickening and desquamation of epithelium, most marked in the lower part of the cornea, and much punctate staining. Superficial vascularization of the cornea (fig. 8 *A*), slight marginal atrophy of the iris and moderate retinal arteriosclerosis were present. There was diminished lacrimation in each eye (a 5 mm. filter paper moistened 4 mm. in five minutes). The pericorneal blood vessels were normal. There was moderate facial rosacea. The visual acuity was 20/70. On July 18 the pericorneal blood vessels were obliterated with a diathermy needle from 2 to 10 o'clock (fig. 8 *B*). On July 22 the wound showed no staining. The entire cornea was smooth and did not stain except in the quadrant of the cornea adjacent to the untreated area. There was some subjective improvement. On August 5 no change was noted. On September 25 there was a slight recurrence of staining over the entire cornea. The visual acuity was 20/40.

CASE 9.—E. F. S., a man aged 41 (a patient of Dr. W. B. Lancaster), had his first attack of ocular inflammation in August 1933 during a long motor trip, at which time the eyes were exposed to much wind and glare. Bilateral corneal ulcers developed, which persisted for five weeks. A similar attack, lasting ten days, occurred during May 1934, and a third attack, lasting seven days, during November 1934. The fourth attack, the only one observed by me, began Jan. 31, 1935. It was by far the most severe. Both eyes showed extreme photophobia and marked congestion. There were multiple discrete gray infiltrates in the epithelium and anterior stroma of each cornea. Less than half of the lesions stained. There was superficial vascularization from many points about the limbus. No iritis was present. The lids were inflamed but showed no evidence of trachoma. Conjunctival smears showed no eosinophils. There were a few staphylococci and Bacillus xerosis in smears as well as in cultures. Physical examination gave essentially negative results, except for facial rosacea. The intradermal reaction to 0.1 mg. of old tuberculin was strongly positive. Roentgen examination of the chest gave negative results. There was evidence of a slight nonspecific chronic prostatitis. Gastric analysis showed a normal hydrochloric acid content. The patient showed no improvement after treatment at home for eighteen days and was admitted to the Massachusetts Eye and Ear Infirmary on February 17. The right cornea was more involved than the left and showed a large area of infiltration in the lower part of the pupillary space. There were smaller infiltrates (fig. 9 *A*) in the upper half of the cornea, with superficial vascularization. On February 19 the conjunctiva was loosened from the limbus above, and the blood vessels crossing the corneal limbus were obliterated (fig. 9 *B*). The patient remained in the hospital for twenty-one days, during which time there was slight though gradual improvement in each eye. He was then transferred to a convalescent hospital, where he remained for twelve weeks. He has since returned to his work as a practicing dentist and has had no subsequent attacks.

CASE 10.—A. DeS., a woman aged 29, had suffered from inflammation of the right eye for the first time six years before the present attack. She had received treatment at another hospital and in the outpatient department of the Massachusetts Eye and Ear Infirmary, and there had been some regression of symptoms at

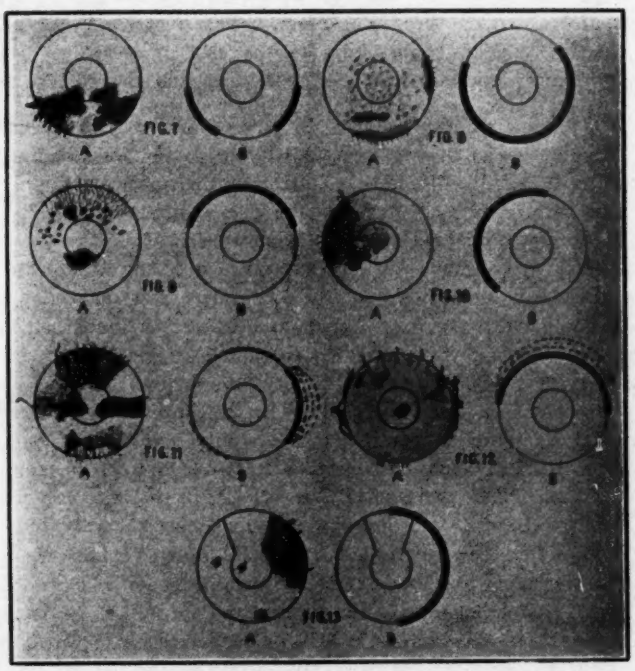
times, but many periods of acute exacerbation, and no definite improvement from local treatment. There was moderate facial rosacea. The Wassermann reaction of the blood was negative. The intradermal reactions to 0.01 mg. of old tuberculin were negative. Little hypesthesia was present. There was a fairly dense superficial infiltrate in the upper outer corneal quadrant (fig. 10 *A*). Superficial vascularization was marked, and there was some deep vascularization throughout the lesion. There was an ulcer, 1.5 by 2 mm., at the end of the fasciculus. On Sept. 4, 1935, the superficial vessels at the limbus were obliterated (fig. 10 *B*). Two days after operation the eye felt much better, and there was a definite diminution in the size of the ulcer. The staining area measured 1 mm. in diameter. By September 9 the eye was almost quiet, and the ulcer was reduced to the size of a pinpoint. The vessels showed some return of circulating blood. On October 18 it was found that there had been a recurrence of symptoms, and the ulcer had increased to its original size. The blood vessels were again obliterated in the same area. Again a definite shrinking in the size of the ulcer was observed, and three weeks after operation the eye was quiet and the cornea did not stain.

CASE 11.—C. M., a woman aged 48 (a patient of Dr. J. J. Regan), had had continuous inflammation of the right eye since 1930, except for a complete remission of twelve months during 1934 to 1935. Tuberculin therapy was administered during 1933, 1934 and 1935. During July 1935 the eye again became inflamed, and the inflammation continued unabated until November 26, when the patient was first seen by me. The right eye was moderately congested and showed multiple areas of scarring and infiltration (fig. 11 *A*). There was marked superficial and deep vascularization, with an ulcer 2 mm. in diameter in the nasal border of the pupillary space. No posterior corneal deposits could be seen. The aqueous was too obscured for careful study. The visual acuity was 4/200. The left eye showed a superficial stromal scar 2 mm. in diameter in the upper outer corneal quadrant. General physical examination gave negative results except for moderate facial rosacea. No focal infections were found. On November 26 the conjunctiva was dissected from the limbus and underlying sclera, from 2 to 4 o'clock, and the superficial blood vessels at the limbus and on the sclera were obliterated with the diathermy needle. Likewise the individual blood vessels were obliterated at the limbus in the upper and lower temporal quadrants (fig. 11 *B*). The retracted conjunctiva was then pulled toward the cornea and sutured in position. Examination on December 2 showed the eye to still be moderately congested, but the ulcer showed no staining, although it was still slightly faceted. The eye became entirely white during the succeeding month, and the patient was asymptomatic when last seen on March 5, 1936.

CASE 12.—E. R., a man aged 50, experienced his first attack of ocular inflammation during 1926. Since then a great many corneal ulcers had appeared on both eyes. The visual acuity during the six months preceding the patient's admission to the hospital had diminished, so that he had been forced to abandon an active surgical practice. No treatment had given any permanent relief. Careful physical examination revealed only the following abnormalities: marked facial rosacea, a basal metabolic rate of —10, mild achylia gastrica and apical scars in both lungs. Examination on Nov. 19, 1935, showed slight congestion of the right eye and moderate congestion of the left eye. There were diffuse infiltration and superficial scarring of both corneas. The epithelium was thickened and slightly rough. There was slight superficial vascularization, especially in the upper part of the left cornea from 10 to 2 o'clock, extending 3 mm. beyond the limbus. There was a

TABLE 3.—*Summary of Cases of Ocular Rosacea (Group 2)*

No. of Case	Summary	Result
7	Localized keratitis, 27 weeks' duration; arrested in 16 days; slight temporary recurrence 6 weeks after operation	Excellent
8	Marked keratitis epithelialis, probably of several years' duration; striking immediate improvement; no permanent cure	Fair
9	Severe keratitis, 7 weeks' duration before operation; gradual improvement not directly related to operation	No improvement
10	Severe recurring ulcers of 6 years' duration; marked reduction in size of ulcer after each of 2 operations; no cure	Fair
11	Ulcer of 20 weeks' duration; arrested in 6 days; no recurrence	Excellent
12	Small ulcer in pupillary space, of unknown duration (probably many weeks); arrested in 2 days; no improvement in general condition	Fair
13	Severe ulcer of 16 days' duration; arrested in 4 days; no recurrence	Excellent



Figs. 7–13.—Diagrams illustrating cases of ocular rosacea.

staining ulcer 1 mm. in diameter just below the corneal center (fig. 12*A*). No deposits were seen on the posterior corneal surface, nor were any cells observed in the aqueous. There was no corneal hypesthesia. Epiphora was marked in both eyes. On November 20 obliteration of the pericorneal blood vessels was performed. The conjunctiva of the left eye was loosened from the limbus from above, from 9 to 3 o'clock, and the anterior ciliary vessels were lightly coagulated with the diathermy needle for a distance of 3 mm. behind the limbus (fig. 12*B*). The patient made an uneventful convalescence and was discharged from the hospital on November 28. The ulcer showed no staining twenty-four hours after operation, but considerable keratitis epithelialis remained in the lower half of the cornea. After the operation there developed in the posterior corneal surface many fine folds, which persisted for one week. The eye remained rather irritable and

teared profusely, but showed gradual improvement up to the time of the patient's discharge from the hospital on November 28. He was given general and local treatment for the ocular rosacea. Since discharge there has been some improvement in the ocular rosacea but there have been recurrences of the keratitis.

CASE 13.—J. K., a man aged 36, was first seen on March 9, 1936. The left eye had been sore and red for seven days. Five years previously the patient had been under treatment for six months in the Massachusetts Eye and Ear Infirmary for a severe attack of keratitis, secondary iritis and glaucoma. Several paracenteses and iridectomy were performed. The cause of the keratitis could not be determined, although it was thought to be the type which is associated with acne rosacea. The eye showed marked congestion, and on the cornea there was a highly vascularized ulcer, 2 by 3 mm. in size, 4 mm. from the limbus in the upper outer quadrant. There were several isolated corneal scars (fig. 13 *A*). Slight secondary iritis was present, but the intraocular pressure was not elevated. The eye was treated with atropine, zinc oxide and an ichthammol ointment and was bandaged, but no improvement occurred. On March 18 the superficial pericorneal blood vessels were obliterated from 12 to 6 o'clock (fig. 13 *B*). The eye improved rapidly thereafter. The discomfort ceased twenty-four hours after operation, and four days following there was no staining of the ulcer or operative wound. On March 1 the eye was entirely quiet.

GROUP 3: PRIMARY SUPERFICIAL KERATITIS, PROBABLY TUBERCULOUS

CASE 14.—M. C., a woman aged 29, was first seen on March 24, 1933, with an atypical superficial punctate keratitis of both eyes, more active in the right. She complained of recurring attacks of ocular inflammation for the preceding year. Physical examination revealed a tall, thin, frail-looking woman in fairly good health. Roentgen examination of the chest showed old scars in the apexes of both lungs but no active tuberculosis. The reaction to 0.0025 mg. of old tuberculin was positive. The Wassermann reaction of the blood was negative. No focal infections were found. The patient was seen at regular intervals during the following year, and all local and general therapy failed to arrest the inflammation in the right eye. An ulcer, 3.5 by 1 mm., developed in the lower part of the cornea; it became vascularized and gradually advanced into the upper part of the pupillary space (fig. 14 *A*). The visual acuity of the right eye decreased to 20/70 +2; that of the left eye remained 20/20. There was no evidence of intraocular inflammation, but the eye was constantly congested. On May 23, 1934, the vascularization was chiefly superficial, but there were some stromal vessels also. On May 24 obliteration of the pericorneal blood vessels from 5:30 to 7 o'clock was performed with the diathermy needle, which was carried into the posterior corneal stroma (fig. 14 *B*). Examination on June 8 showed that the ulcer had decreased rapidly in size and ceased staining five days after operation. A small hematoma formed in the cornea, which absorbed completely in ten days. The eye was white and quiet, and the administration of atropine was discontinued. On August 17 it was found that the right eye had remained practically asymptomatic until twenty-four hours previously, when it again became inflamed; it showed slight congestion, and an ulcer 2 mm. in diameter was seen in the lateral portion of the pupillary space. There had been considerable reformation of blood vessels in the previously vascularized area. On August 18 the vessels which had reformed around the margin of the previous wound of operation were obliterated, the same method being used

that was employed previously. The ulcer again showed a rapid diminution in size after operation, but a faintly staining point remained until October 20, when it disappeared and the eye became asymptomatic. On July 25, 1935, it was found that the patient had had no major corneal inflammations since the last operation. On two occasions, minute staining ulcers formed in the previously affected area but healed within a few days.

CASE 15.—L. G., a Negro aged 55, first seen on Jan. 11, 1934, had had attacks of painful inflammation in both eyes in childhood. The left eye had always been more involved than the right. The present attack in the left eye was of about ten days' duration. Examination on March 31 showed that the patient had not responded to the regular treatment for ulcer in the ophthalmic clinic. Vision was more blurred (20/40), and there was slight congestion. An ulcer, 1 by 2 mm., was observed in the pupillary area. There was marked superficial and deep vascularization (fig. 15 *A*). Scattered fine deposits were present on the posterior corneal surface. There were few aqueous cells. The Hinton reaction of the blood was negative. The intradermal reaction to 0.1 mg. of old tuberculin was positive. No focal infection was found. Obliteration of the corneal vessels at the limbus from 5 to 7 o'clock was done with a diathermy needle (fig. 15 *B*). The corneal stroma was incised to approximately half of its depth. The majority of the vessels were interrupted. On April 2 there was marked subjective improvement. The ulcer was reduced to one third of its size before operation. On April 7 the eye was white, and the ulcer showed a faint point of stain. On April 11 there was no staining of the ulcer. On June 29 examination revealed that the patient had been practically asymptomatic since the operation. The eye was white and quiet, and there was no staining of the cornea.

CASE 16.—M. B., a woman aged 42, first had an ocular inflammation following measles in childhood. Mild attacks occurred again at the age of 34, but no severe inflammation was present until four years before the present attack, when both eyes were inflamed for five weeks. The present attack began in the right eye four months before admission to the hospital and in the left eye two months before. The patient had been under treatment in the outpatient department for a month. Examination showed the right eye to be white and quiet, with a visual acuity of 20/50. There were several punctate and fusiform scars in the superficial corneal stroma, with practically no vascularization. The left eye was slightly congested and showed marked epiphora and photophobia. There was no corneal hypesthesia. There were a diffuse infiltrate in the epithelium and superficial corneal stroma and four discrete staining ulcers (fig. 16 *A*). There was marked superficial vascularization of the cornea extending into the pupillary space, especially in the upper, outer and lower portions. The visual acuity, with a 2 mm. pinhole, was 20/70 + 2. On April 16, 1934, obliteration of the pericorneal blood vessels was performed in the lower half of the cornea with the diathermy needle (fig. 16 *B*). The incision was carried through the epithelium and into the most superficial fibers of the corneal stroma. By April 18 there had been little change in symptoms. There was no staining of the cornea. The globe was still congested. On May 3 the eye was practically white although there was still some photophobia. On Sept. 26, 1935, it was found that both eyes had been asymptomatic, white and quiet since the last visit. The patient felt that the operation had been of definite help. In conjunction with the operative procedure, the patient received a course of injections of tuberculin from March 1, 1934, to Nov. 7, 1935.

CASE 17.—In R. C., a Negro girl aged 13, phlyctenular keratitis developed in both eyes at the age of 2 and persisted almost without interruption until the age of 8. There had been a recurrence in the left eye one year before the present attack. Physical examination gave negative results. Roentgen examination of the chest showed a supracardiac shadow, suggesting enlargement of the hilar glands. The intradermal reactions to 0.001 mg. of old tuberculin were positive. The Wassermann reaction of the blood was negative. No form of local therapy had been of any marked benefit. The right eye was white but showed several old corneal scars. The left eye was moderately congested and showed marked photophobia and lacrimation. There was diffuse scarring of practically the entire cornea with many areas of denser infiltration. Scattered irregularly over the cornea were ten staining ulcers, approximately 1 mm. each in size. There was superficial vascularization, most marked from 4 to 6 o'clock (fig. 17 *A*). Examination with the slit lamp showed no evidence of intraocular inflammation. On Jan. 15, 1935, obliteration of the pericorneal blood vessels from 4 to 6 o'clock was carried out with the diathermy needle. The incision was carried into the superficial corneal stroma (fig. 17 *B*). The report of January 19 stated that the patient had had an uneventful convalescence. The symptoms of irritation had largely decreased, and the cornea showed no staining. On Jan. 25, 1936, there was a slight recurrence of symptoms. There were many fine staining points in the lower half of the cornea. On January 30 both eyes were white and quiet. The patient was able to return to school. After operation the patient made several visits to the hospital. On only two visits was there the slightest evidence of corneal inflammation. Examination on March 23 showed that there had been a reestablishment of circulation in a few vessels in the lower portion of the left cornea. The visual acuity was 20/50 in the right eye and 20/30 in the left eye.

CASE 18.—P. V., a girl aged 12 years, was seen on July 25, 1935. For the preceding five years, almost continually, she had had a diffuse phlyctenular-like keratitis of both eyes, the cause of which could not be determined. Tuberculin tests had been consistently negative. Physical examination showed no evidence of tuberculosis. Roentgen examination of the lungs showed some increased density of the shadow of each hilus. The Wassermann reaction of the blood was repeatedly negative. No focal infections could be found. Sensitization tests showed no reaction to the usual proteins. The patient was admitted to the Lakeville State Sanatorium on April 12, 1932, and remained there until May 29, 1932. It was then thought that there was insufficient evidence for a diagnosis of tuberculosis to warrant the continuation of care in the sanatorium. Examination on July 25, 1935, showed slight congestion of both eyes, with diffuse scarring of both corneas and many localized areas of denser infiltration. The entire surface of both corneas showed marked vascularization and roughness, and there was some fine punctate staining—keratitis epithelialis disseminata (fig. 18 *A*). Examination with the slit lamp showed no evidence of intraocular inflammation. The visual acuity in the right eye was 20/20 and in the left eye 4/200. Obliteration of the pericorneal blood vessels was performed in the left eye with the diathermy needle (fig. 18 *B*). The incisions were superficial and interrupted, particular attention being directed toward the large blood vessels. On August 7 the eye was white and quiet. The patient had had an uneventful convalescence. Examination on October 2 showed that the left eye had continued to improve. The visual acuity was 8/200.

CASE 19.—D. M., a girl aged 7 years, was seen on July 28, 1934. For the preceding five years she had had recurring attacks of phlyctenular keratitis in

both eyes, more frequently in the right. Attacks were often associated with common colds and appeared practically every month except during the summer. General physical examination gave negative results. Roentgen examination of the lungs showed no evidence of tuberculosis. Intradermal reactions to 0.01 mg. of old tuberculin were negative. The right eye was moderately congested and showed several active lesions typical of phlyctenular keratitis. These were concentrated in the upper half of the cornea, where there was marked vascularization downward to the upper pupillary border (fig. 19 *A*). Slit lamp examination could not be made. The left eye showed a similar picture, but much less marked. With the patient under ether anesthesia, obliteration of the pericorneal blood vessels was performed at the upper limbus, from 10 to 2 o'clock (fig. 19 *B*), with the diathermy needle. The patient made a slow but uneventful recovery from the operation. Both eyes have been much improved since operation. The attacks of inflammation have been fewer in number and of less severity. Vascularization of the upper part of the right cornea has returned to a considerable extent, but is less marked than prior to operation.

CASE 20.—T. K., a man aged 36, was seen on Oct. 18, 1935, because of moderate to severe symptoms of corneal inflammation of the left eye for three months. There had been a similar attack ten years before, which had lasted for several months. The eye was slightly congested. There were marked lacrimation and photophobia. The cornea was diffusely and irregularly scarred, and there were two staining ulcers (fig. 20 *A*). The corneal epithelium was slightly vascularized at 8 and 11 o'clock, and there were a few vessels in the stroma. No form of local treatment had been of any value. General physical examination gave negative results. The Wassermann reaction of the blood was negative. A few teeth with apical abscesses had been extracted during the preceding attack without benefit. The intradermal reaction to 0.0025 mg. of old tuberculin was positive. There was no corneal hypesthesia. Examination with the slit lamp showed no evidence of intraocular inflammation. The visual acuity was 20/200. Obliteration of the pericorneal blood vessels was performed at the limbus from 6 to 8 o'clock and from 10 to 12 o'clock. The diathermy needle was carried only through the epithelium in these regions (fig. 20 *B*). The eye showed increased redness and was rather uncomfortable for twenty-four hours after the operation, when, on October 28, some improvement was noted. Seven days after operation, although there was slight congestion, there was absolutely no corneal staining. Examination on December 16 showed that the improvement was of short duration. Six weeks after operation there was a small ulcer in the same region and a recurrence of symptoms.

CASE 21.—C. P., a man aged 22, was seen on Sept. 25, 1935. At the age of 6 years, he had his first attack of keratitis in the right eye which was of a few weeks' duration. Two years before the present attack he had a recurrence, lasting six weeks. A third attack, lasting only a week, developed nine months before. After this attack the eye was well for two weeks, then again became inflamed. The eye was particularly sensitive during warm weather. Photophobia and epiphora were predominating symptoms, but there was not much pain. The eye was slightly congested. The cornea showed diffuse superficial scarring with mottling due to areas of increased density. The corneal epithelium was slightly rough throughout. A staining ulcer, 1 by 2 mm. in diameter, was present (fig. 21 *A*), and there was practically uniform superficial vascularization about the periphery of the cornea, extending over the limbus from 3 to 4 mm. Examination with the slit lamp showed no evidence of intraocular inflammation. General

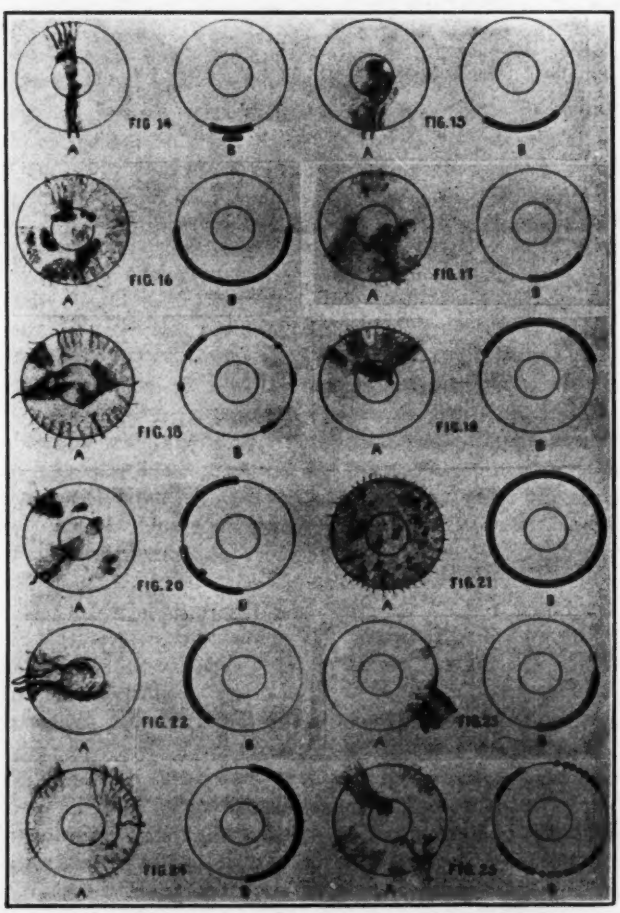
physical examination gave negative results. The Wassermann reaction of the blood was negative. Intradermal reactions to 0.01 mg. of old tuberculin were negative. Roentgen examination showed normal accessory nasal sinuses and an apical abscess of one tooth, which had been treated. The visual acuity was reduced to 20/40. Complete obliteration of the pericorneal blood vessels was done with the diathermy needle; the point was carried through the epithelium of the limbus (fig. 21 *B*). The patient had some discomfort for two hours after operation. On September 28 the eye showed moderate congestion but no staining of the ulcer or of the wound. On October 14 the right eye was completely white and quiet, and the cornea showed no staining. On October 21 the patient again had some symptoms of irritation in both eyes. There was a staining area the size of a pinpoint in the upper part of the right cornea. The visual acuity had returned to 20/20. The patient has not returned for observation since October 21 and presumably is well.

CASE 22.—L. B., a girl aged 4 years, was seen on Feb. 21, 1935. She was referred from the Blind Babies' Nursery, where she had been treated for recurring attacks of phlyctenular keratitis of both eyes since infancy. The left eye had been inflamed and had resisted treatment for three months prior to the present examination. There was marked irregularity of the corneal surface, with dense infiltration and superficial vascularization (fig. 22 *A*) and some folliculosis in both fornices. Obliteration of the pericorneal blood vessels was performed at the limbus from 7 to 10 o'clock with the diathermy needle (fig. 22 *B*), local anesthesia being used. The patient was immediately returned to the institution. On December 10 a report by Dr. H. B. C. Riemer, oculist of the Blind Babies' Nursery, stated: "The eye was white and quiet seven days after operation. There has been considerable improvement in the amount of inflammation present. The patient has had two minor attacks of inflammation since, each lasting three or four days."

CASE 23.—R. E. K., a man aged 48 (a patient of Dr. M. J. King) was seen on April 3, 1934. The right eye first became sore ten months before. He had had recurring attacks of inflammation since then, with remissions lasting no longer than from seven to ten days. During these attacks the eye became congested and slightly sore and showed considerable photophobia and lacrimation. There were a moderately dense scar in the upper inner quadrant of the cornea and a large, broad, well vascularized pseudopterygium crossing the limbus for a distance of 2.5 mm. in the lower inner quadrant (fig. 23 *A*). At times there had been small staining ulcers at the border of the pseudopterygium. Examination with the slit lamp showed no evidence of intraocular inflammation. General physical examination gave negative results. The Wassermann reaction of the blood was negative. No focal infections were found. The intradermal reaction to 0.0025 mg. of old tuberculin was positive. The patient had received treatment with tuberculin for six months before the present examination. Obliteration of the pericorneal blood vessels from 3 to 6 o'clock was performed with the diathermy needle. The incision was carried into the superficial corneal stroma at the limbus (fig. 23 *B*). According to a report on April 10, the patient had considerable pain for twenty-four hours after operation, and the cornea showed staining of the wound for forty-eight hours, with a slight hematoma in the region of the pseudopterygium. Marked improvement occurred during the four days prior to April 10. A report on June 16, 1936, showed that the patient had continued to improve and that there had been practically no attacks since operation.

TABLE 4.—*Summary of Cases of Primary Superficial Keratitis, Probably Tuberculous (Group 3)*

No. of Case	Summary	Result
14	Ulcer of over 12 months' duration; arrested in 9 days; recurrence in 3 months	Fair
15	Ulcer of 13 weeks' duration; arrested in 11 days; no recurrence	Excellent
16	Multiple small ulcers of 9 weeks' duration; arrested in 6 days; also treated with tuberculin	Fair
17	Multiple fine ulcers of lower part of cornea of 12 months' duration; arrested in 9 days; minimal recurrence; marked general improvement	Good
18	Severe superficial keratitis with punctate staining of several years' duration; eye white and quiet in 3 weeks	Good
19	Severe superficial keratitis of several years' duration; no definite improvement	No improvement
20	Ulcer of 3 months' duration; much improved 7 days after operation; recurrence in 6 weeks	No improvement
21	Ulcer of 8 months' duration; completely arrested in 14 days; slight recurrence 2 weeks later	Fair
22	Severe, superficial keratitis, 3 months' duration; arrested in 7 days; slight recurrence	Fair
23	Regularly recurring ulcers at head of pseudopterygium for 8 months; healing of ulcers in 4 days; marked reduction in recurrences; tuberculin therapy also	Fair
24	Pseudoptergyium for 20 years; occasional attacks of inflammation; ? of diminution in number of attacks; tuberculin therapy also	No improvement
25	Pseudopterygium with ulcer at its head, 2 weeks' duration; ulcer arrested in 14 days after transplantation of pseudopterygium and obliteration of limbal vessels; no recurrence	Excellent



Figs. 14–25.—Diagrams illustrating cases of primary superficial keratitis, probably tuberculous.

CASE 24.—T. E. H., a man aged 68 was seen on March 22, 1934. For approximately twenty years he had had recurring attacks of ocular inflammation. Both eyes had large, rather dense pseudopterygia at the inner and outer limbus, more marked at the former. Only the right eye showed active inflammation, and this was slight. The extent of the pseudopterygium and approximate vascularization of the right eye are shown in figure 24 *A*. The vascularization was chiefly superficial, although there were some deep vessels. Examination with the slit lamp showed no evidence of intraocular inflammation. General physical examination showed no systemic disease. The intradermal reaction to 0.0025 mg. of old tuberculin was positive. Obliteration of the pericorneal blood vessels from 12 to 6 o'clock was performed with the diathermy needle. The incision was carried into the superficial corneal stroma at the limbus (fig. 24 *B*). On March 24 the eye was slightly congested. There was no staining of the wound. On Jan. 23, 1935, the patient stated that he felt that the right eye had improved considerably since operation. There had been less discomfort, and the visual acuity was slightly better. There has been no advancement in the pseudopterygium since operation. The blood supply has been definitely decreased by the operation and is now considerably less than in the pseudopterygium of the opposite eye.

CASE 25.—A. T. B., a woman aged 46, was seen on Nov. 15, 1935. Five years before she had been treated for four months at a local hospital for a corneal ulcer of the left eye. Three years before a second attack occurred lasting two and a half months. Two weeks before the left eye again became sore and became steadily more inflamed in spite of treatment. The right eye was white and quiet but showed an old scar in the superficial corneal stroma in the upper outer quadrant. The left eye was irritated and showed moderate congestion in focal areas surrounding the limbus. There was marked roughness of the corneal surface and about the periphery were patchy areas of infiltration which were well vascularized to the extent of a pseudopterygium formation at 7:30 and 10:30 o'clock. At the end of the upper pseudopterygium there was a staining ulcer, 1 by 2 mm. (fig. 25 *A*). There were a few cells in the aqueous. The visual acuity was 20/50. General physical examination gave negative results except for moderate facial rosacea. The intradermal reaction to 0.0025 mg. of old tuberculin was negative. In spite of the negative test for tuberculosis and the presence of facial rosacea, the corneal lesions appeared to be most characteristic of tuberculosis. The upper pseudopterygium was dissected from the cornea and transplanted under the conjunctiva above, local anesthesia being used. The lower pseudopterygium was excised, and the cut blood vessels were coagulated by the diathermy needle. Also, the individual vessels which could be seen were cut off at the limbus with the diathermy needle (fig. 25 *B*). According to the report of November 29 there was considerable added discomfort for two days after operation. Congestion increased considerably, and several scattered hematomas developed under the epithelium. There was then marked improvement in symptoms and the corneal ulcer healed on the fourteenth postoperative day. Examination on December 18 showed no recurrence. The eye was completely white and quiet.

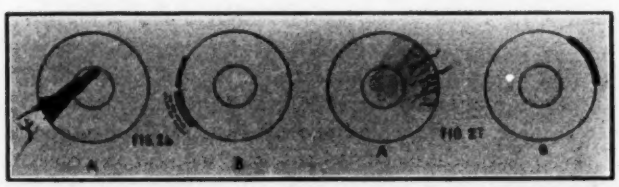
GROUP 4: KERATITIS FOLLOWING TRAUMA

CASE 26.—A. F., a boy aged 14 years, on Aug. 11, 1928, had sustained a nonperforating laceration of the right cornea from the limbus at 8 o'clock to the upper pupillary area and was successfully treated in the outpatient department. He was first seen by me on July 1, 1931. The patient thought that the scar was growing.

It was vascularized throughout. The eye was white, and the visual acuity was 20/20. On Jan. 31, 1933, there was slight congestion of the scar and adjacent limbus. On December 19 the patient complained that the eye became sore and congested at intervals, lasting a few days; the eye was particularly sore when the patient had an infection of the upper part of the respiratory tract. The scar was prominent and markedly vascularized from the midstroma outward. There were from five to ten staining dots along the lower border of the scar in the pupillary space. There were no cells in the aqueous. The visual acuity was 20/30. According to the report of Feb. 23, 1934, the eye became very sore twenty-four hours previously after vigorous physical exercise and exposure to cold. The patient had

TABLE 5.—*Summary of Cases of Keratitis Following Trauma (Group 5)*

No. of Case	Summary	Result
26	Recurring ulcers in old corneal laceration, 10 weeks' duration; arrested in 7 days after vascular obliteration	Excellent
27	Keratitis resulting from mustard gas; tuberculous keratitis (?), 17 years' duration; deep vessels incised with keratome	No improvement



Figs. 26–27.—Diagrams illustrating cases of keratitis following trauma.

a "cold." The eye was slightly congested, and there was no pus in the conjunctival sac. There was a staining linear ulcer along the lower border of the scar. The entire lesion was red and slightly elevated (fig. 26 *A*). There were many cells and some fibrin in the aqueous. The visual acuity was 20/100. On February 26, while rubbing the eye, the patient experienced a sudden pain, and there was a gush of fluid from the eye. Examination the next day showed a perforated ulcer with a prolapsed iris. The anterior chamber reformed. The patient was admitted to the infirmary for immediate treatment. Operation was performed by Dr. F. H. Verhoeff. There was a single corneal suture over the ulcer. Attempts to reduce the incarcerated iris through the wound failed. A small keratome incision was made temporarily above the fasciculus. The anterior chamber refilled with saline solution. The iris was dislodged from the ulcer with a spatula. The suture was tied. The conjunctiva and vessels entering the scar were incised, and the vascular reticulum was scarified (fig. 26 *B*). On March 7 the patient was discharged from the infirmary. There was slight congestion and the iris was free from the cornea. There was no corneal staining, and few cells were seen in the aqueous. On March 22, the eye was white. By October 26 there had been no return of symptoms since operation. The visual acuity was 20/15.

CASE 27.—J. S., a man aged 36, was seen on Feb. 21, 1935. He had received a mustard gas burn of both corneas while serving in the American Expeditionary Forces in 1918. Both eyes had been inflamed almost constantly ever since, totally incapacitating the patient. He had had thorough ocular and physical examinations

at the Walter Reid Hospital. No definite diagnosis had been made. He had been under continuous treatment at the Massachusetts Eye and Ear Infirmary since 1931, with practically no improvement. Focal infections had been eliminated. Repeated physical examinations gave completely negative results. The intradermal reaction to 0.0025 mg. of old tuberculin was positive.

The right eye was more involved than the left. It showed a dense infiltration of the cornea, occupying practically the entire nasal half. The corneal surface was irregular. There were many deep and a few superficial vessels entering this area between 1 and 4 o'clock (fig. 27 *A*). The eye had shown a little evidence of intraocular inflammation, but only occasionally. There was slight congestion, but marked irritation. A keratome incision was made at the limbus from 1:30 to 9 o'clock in an attempt to sever the blood supply of this area of inflammation (fig. 27 *B*). On March 28 there were no untoward consequences from the operation. Slight hyphemia developed, but this disappeared within a week. The eye whitened to its previous condition within two weeks and has shown no change since. In the deep stroma of the cornea there was some postoperative hemorrhage, but this also disappeared. Examination on June 11, 1936, showed that the eye continued to be irritable. There was no benefit from the operation.

GROUP 5: LIPIN INTERSTITIAL KERATITIS

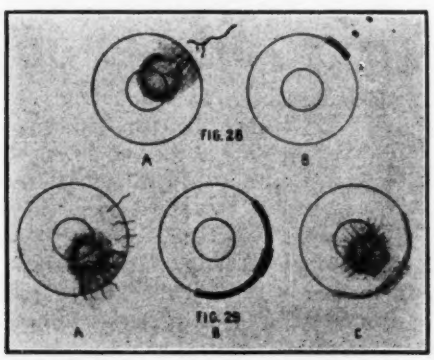
CASE 28.—K. D., a woman aged 47, was seen on April 16, 1934, complaining of slight irritation of the left eye. Examination showed faint congestion, and there was a fresh area of infiltration in the central and upper portions of the cornea, evidenced by edema of the corneal surface, posterior bowing and many folds in the posterior surface. There were a few cells in the aqueous and scattered deposits on the endothelium. The intraocular pressure was slightly reduced. The visual acuity was 15/200. This condition of the cornea remained almost stationary for the following six months, when, in spite of diminishing congestion, there was an increase in the amount of infiltration in the posterior corneal stroma, consisting of a deposition of fine white spiculated, crystalline-looking material. There had been some ingrowth of blood vessels along Descemet's membrane, although there was some diminution in the number of folds of the posterior surface and in the amount of edema of the anterior surface. There was a gradual increase in the white deposit in the anterior corneal stroma. The deposit assumed a discoid shape, with slight clearing toward the center. There was also in this area a considerable amount of amorphous yellowish deposit, which appeared to be lipoidal. Sixteen months after the onset the appearance was as shown in figure 28 *A*. General physical examination revealed a rather asthenic-looking woman who was suspected of having tuberculosis, though this was never proved roentgenographically. There were no focal infections. The Wassermann reaction of the blood was negative. The intradermal reaction to 0.005 mg. of old tuberculin was positive. On Aug. 16, 1935, the deep blood vessels were obliterated from 1:30 to 2:30 o'clock as they crossed the limbus (fig. 28 *B*), local anesthesia being used. The diathermy needle was carried into the depths of the stroma without perforating the anterior chamber. There was little reaction after the operation. On August 27 examination with the slit lamp showed complete obliteration of practically all the deep stromal vessels. There was still some faceting of the operative wound. As far as could be determined from photographs taken before operation, there had been no advance in the amount of corneal infiltration up to Feb. 15, 1936. There had been some reestablishment of circulation to the area, but only a small fraction of what it was before operation.

CASE 29.—G. K., a man aged 52, had been under constant observation and treatment for six years for an obstinate iritis and keratitis of the left eye. The

keratitis was considered to be tuberculous in origin. He had had recurring chronic attacks. The eye had almost never been entirely quiet. All standard forms of local treatment had been used, including a course of tuberculin therapy and rest in a sanatorium for five months. The patient had a seasonal vasomotor rhinitis and showed a sensitivity to ragweed and timothy pollen. In November 1934 a deep, yellow, discoid infiltrate developed in the cornea. This infiltrate progressed rapidly in size. On Oct. 22, 1935, there was moderate congestion. The corneal surface was smooth. The discoid infiltrate was fairly sharply

TABLE 6.—*Summary of Cases of Lipin Interstitial Keratitis (Group 5)*

No. of Case	Summary	Result
28	Rapidly increasing fat deposit in cornea for 16 months; arrested by vascular obliteration	Good
29	Tuberculous keratitis with fat deposit; present inflammation 1 year; arrested by vascular obliteration; slight recurrence of scleritis 1 month later; severe recurrence 16 months later	Good



Figs. 28-29.—Diagrams illustrating cases of lipin interstitial keratitis.

defined, practically filling the lower outer quadrant, measuring approximately 5 mm. in diameter (fig. 29 *A*). There was great vascularity, especially in the midstromal region. There were few cells in the aqueous and no deposits on the posterior corneal surface. The tension was normal. Vision was 18/200. The corneal vessels were obliterated with the diathermy needle, superficially from 2 to 7 o'clock and deeply from 4 to 6 o'clock (fig. 29 *B*). The stroma of the limbus was incised to approximately half its depth, obliterating most of the blood supply to the infiltrated area. On October 25 no subjective change was observed. The vessels showed no circulating blood. A fan of endothelial folds developed, extending radially outward from the infiltrated area (fig. 29 *C*). By November 8 definite subjective and objective improvement had taken place. On November 15 the patient was asymptomatic. The eye was white. During the week preceding December 6 the patient had a mild attack of scleritis in the left eye at 12 o'clock. On December 20 the eye was white, and the visual acuity was 20/100.

GROUP 6: TRACHOMATOUS KERATITIS

CASE 30.—A. La P., a man aged 21, was seen on Sept. 27, 1934. He gave a history of ocular irritation of four and a half months' duration. There was marked ptosis of the left upper lid. Examination showed slight congestion of the bulbar conjunctiva. The upper fornix was beefy red, with several large

translucent follicles and marked thickening of the conjunctiva. There was marked irregularity of the corneal surface, especially of the upper half, with a diffuse stippling, which stained lightly. In the upper and outer half of the cornea there was marked pannus formation. The lower limbus showed an early pannus (fig. 30 *A*). The right eye was normal. General physical examination gave negative results. The Wassermann reaction of the blood was negative. The intradermal reaction to 0.01 mg. of old tuberculin was positive. Roentgen examination of the teeth showed no apical abscesses. The pericorneal blood vessels were obliterated from 11 to 5:30 o'clock, local anesthesia being used. The diathermy needle was carried through the pannus at the limbus only (fig. 30 *B*). On October 5 the patient stated that there had been considerable improvement in symptoms. There was no corneal staining. Following the improvement immediately after operation a temporary recurrence of symptoms and a regrowth of vessels into the cornea to about the former amount took place. The patient was given applications of copper sulfate twice weekly from one week after operation for three months. On December 28 there was marked improvement in symptoms. The eye was practically white. The conjunctiva had cleared remarkably, and the patient was asymptomatic.

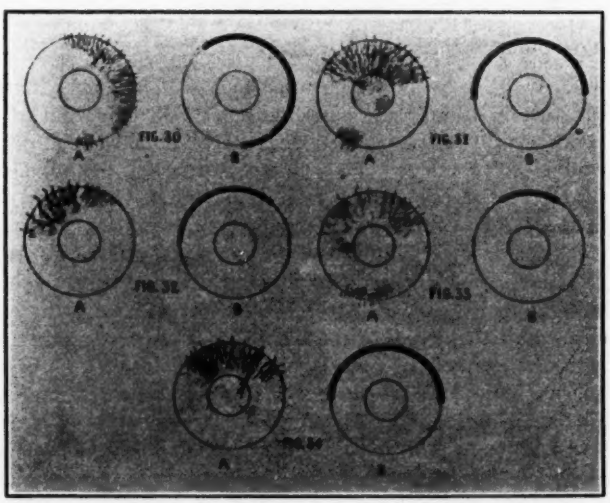
Case 31.—J. A., a professional wrestler aged 31, was seen on July 6, 1935. He contracted trachoma four years before and had had treatment of various kinds since then. Both eyes showed marked active trachoma with ptosis, conjunctival hypertrophy, follicles in both upper fornices and marked pannus above extending to the upper part of the pupillary area. The pannus was more marked in the left eye (fig. 31 *A*). During the two months preceding the present examination the patient had been treated regularly with a copper sulfate stick and drops of zinc sulfate. There had been some improvement of the right eye, but little of the left. Obliteration of the pericorneal blood vessels was carried out in the pannus of the upper half of the left eye (fig. 31 *B*). The diathermy needle was carried through the epithelium and Bowman's membrane of the limbus. The report of October 23 showed that there was marked and rapid improvement of the left eye after the operation. Treatment with copper sulfate was continued in both eyes. The right eye, which had not been peritomized, showed a marked lag in improvement. Peritomy was performed on the right eye on November 27. Owing to the patient's professional engagements in other cities, the postoperative course of the right eye could not be adequately followed.

Case 32.—K. La H., a woman aged 34, was seen on Nov. 6, 1934. She was born in Syria and undoubtedly contracted trachoma in childhood, although the diagnosis was not made until after she came to America in 1921. Treatment had been carried out by Dr. H. B. C. Riemer, who performed tarsectomy on each eye ten years previously. The patient was much improved by the operation but continued to have attacks of ocular inflammation. The Wassermann reaction of the blood was strongly positive. For a year the right eye had been constantly more inflamed than the left. There was slight congestion, and in the upper outer quadrant of the cornea there was a well marked pannus, at the border of which were several rough, faintly-staining infiltrates (fig. 32 *A*). The upper conjunctival fornix appeared fairly free from trachoma. Obliteration of the blood vessels was performed at the limbus from 9 to 2 o'clock, local anesthesia being used. The diathermy needle was carried through the blood vessels and epithelium (fig. 32 *B*). On Feb. 16, 1936, the patient said that she had been much improved by the operation. There was little pain after operation. Within two weeks the eye became white and quiet. There was some return of blood vessels in the upper and outer quadrants of the cornea, but the scars decreased in density, as did the roughness of the epithelium.

CASE 33.—L. McM., a girl aged 6 years, was seen on Aug. 3, 1934. She had had constant inflammation of both eyes for the preceding two and one half years. A definite diagnosis had never been made. Both corneas showed superficial punc-

TABLE 7.—*Summary of Cases of Trachomatous Keratitis (Group 6)*

No. of Case	Summary	Result
30	Active trachoma; marked but incomplete improvement by vascular obliteration; also received copper sulfate	Fair
31	Active trachoma; marked improvement after vascular obliteration; also received copper sulfate	Good
32	Chronic trachoma with periodic exacerbations—keratitis; considerable improvement after vascular obliteration	Good
33	Active trachoma in child, 2½ years' duration; marked improvement after vascular obliteration	Good
34	Chronic trachoma with moderate pannus; no definite improvement after vascular obliteration	No improvement



Figs. 30–34.—Diagrams illustrating cases of trichomatous keratitis.

tate staining and small areas of infiltration, particularly in the upper half of each cornea. A well marked but thin pannus entered the pupillary space from above in each eye. The conjunctivas were moderately congested, and both upper lids were beefy red with many translucent follicles. The patient had been admitted to the ward for contagious diseases several times, where various forms of treatment had been administered with limited success. The inflammation responded best to the regular application of crystals of copper sulfate. For a month before the present examination there had been a marked exacerbation of the symptoms, especially in the right eye. The pannus and areas of densest infiltration in the right eye are shown in figure 33 *A*. Obliteration of the pericorneal blood vessels from 10 to 2 o'clock was performed. The diathermy needle was carried well through the epithelium of the limbus (fig. 33 *B*). A biopsy specimen was taken from the upper fornix for pathologic study. This showed "follicular hyperplasia consistent with trachoma." Examination on August 17 showed that there had been marked improvement in the appearance of the eye during the preceding week. The cornea did not stain. The epithelium was smoother, and the vessels much less conspicuous. A report on May 16, 1935, stated that the right eye had

been distinctly the less troublesome one during the past year. It exhibited less pannus, and the corneal appearance was better in every way. The patient continued treatments with copper sulfate in the outpatient department.

CASE 34.—S. Di. M., a man aged 25, was seen on Nov. 9, 1935. He was born in Italy and had had symptoms of trachoma since adolescence. No treatment was given until six weeks before the present examination, when he was admitted to the Massachusetts Eye and Ear Infirmary. Examination showed trachoma of both eyes, more active in the left. There were scarring of the tarsi and thickening of the conjunctiva of both upper fornices with a few scattered lymphoid follicles. Both eyes showed pannus and corneal scars, the left more marked (fig. 34 *A*). Applications of copper sulfate were given, with a slow response, particularly in the left eye. Obliteration of the pericorneal blood vessels was performed in the upper half of the left cornea. The diathermy needle was carried through the epithelium only (fig. 34 *B*). An uneventful convalescence followed the operation. By June 1, 1936, the congestion had diminished until it was approximately as it was before operation. There may have been some improvement in the appearance of the cornea, although it was not marked. There was a return of vascularization to approximately its previous amount. The visual acuity remained unchanged.

GROUP 7: HYPOPYON ULCER

CASE 35.—W. F., a man aged 33 (a patient of Dr. Paul Haire), during March 1935 was struck in the left eye by a piece of ice. The eye was sore for one week and continued to be irritated and slightly congested. A report on July 3 stated that the eye had been sore for the preceding four weeks. There was marked congestion. An oval ulcer, 3 by 4 mm., was present in the upper inner quadrant of the cornea. There was superficial vascularization (fig. 35 *A*). A hypopyon ulcer measuring 1 mm. was present. A direct smear was negative for organisms. Inoculation of a rabbit for herpes gave negative results. On July 9 the patient was admitted to the Massachusetts Eye and Ear Infirmary. No improvement occurred on conservative treatment. The ulcer advanced into the pupillary space (fig. 35 *B*), and the vascularization increased. Although the hypopyon had disappeared, the aqueous was full of cells. The visual acuity was 2/200. A smear showed rare pneumococcus. Inoculation of a rabbit for herpes was again negative. The corneal vessels were obliterated from 9 to 12 o'clock with a diathermy needle (fig. 35 *C*). On July 12 it was found that there had been no advance in the ulcer since operation. The patient was discharged from the infirmary. On July 22 there was definite improvement, only slight congestion remaining. The ulcer was much smaller. On July 25 there was no staining of the ulcer. On August 3 the eye was completely white. On August 29 the patient was asymptomatic.

GROUP 8: UNCLASSIFIED ULCER

CASE 36.—P. F. McN., a man aged 59, was first seen on Oct. 25, 1937, complaining of pain in the left eye for three days. There were moderate irritation and marked congestion. An oval ulcer was found in the cornea near the limbus at 1 o'clock, measuring approximately 2 by 3 mm. in size (fig. 36 *A*). There were slight infiltration of the surrounding cornea and moderate secondary iritis. A subconjunctival injection of epinephrine was given to complete pupillary dilatation, and atropine, fomentations and a bandage were prescribed. A careful search for focal infections showed marked peridental disease. The Wassermann reaction of the blood and also the reactions to tuberculin were negative. The patient

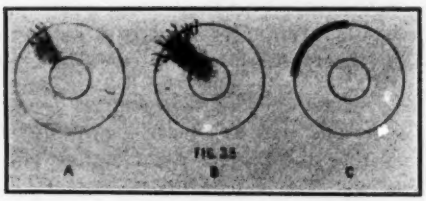


Fig. 35.—Diagram illustrating a case of hypopyon ulcer.

TABLE 8.—*Summary of Case of Hypopyon Ulcer (Group 7)*

No. of Case	Summary	Result
35	Ulcer following injury, 4 months; rare pneumococcus in direct smear; small hypopyon; rapid and complete improvement after vascular obliteration and hospital care	Excellent

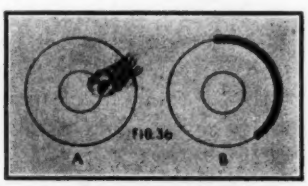


Fig. 36.—Diagram illustrating a case of unclassified ulcer.

TABLE 9.—*Summary of a Case of Unclassified Ulcer (Group 8)*

No. of Case	Summary	Result
36	Advancing ulcer, 15 weeks' duration; promptly arrested after vascular obliteration	Excellent

TABLE 10.—*Summary of Results in All Groups*

Groups	Excellent	Good	Fair	Unimproved
Group 1: dendritic keratitis (keratitis metaherpetica)	4	2	0	0
Group 2: ocular rosacea	3	0	3	1
Group 3: primary superficial keratitis, probably tuberculous	2	2	5	3
Group 4: keratitis following trauma	1	0	0	1
Group 5: lipin interstitial keratitis	0	2	0	0
Group 6: trachomatous keratitis	0	3	1	1
Group 7: hypopyon ulcer	1	0	0	0
Group 8: ulcer unclassified	1	0	0	0
Totals	12	9	9	6

made regular visits to the clinic, and most of the usual remedies were tried. The ulcer showed no tendency to heal. It remained about the same size, but its location on the cornea gradually became more central, until on Feb. 2, 1938, fifteen weeks after onset, it was located about 4 mm. from the limbus. The ulcer was followed by many superficial blood vessels and a few in the midstroma of the cornea. Photographs were taken, and on February 2 the superficial blood vessels were obliterated at the limbus from 12 to 5 o'clock (fig. 36*B*). The eye showed striking improvement in two days, with less staining of the ulcer. Several folds became apparent in the posterior corneal surface and persisted until the seventh day. The ulcer then showed no staining, and two weeks after the operation the eye was completely white and quiet.

SUMMARY AND CONCLUSIONS

The effect of interrupting the blood vessels at the limbus has been observed in 36 cases of various types of keratitis associated with vascularization of the cornea. Considering the chronic nature of the disease in each case, the results were good and leave no doubt that peritomy is of great value in certain corneal conditions.

The assumption that the newly formed blood vessels cause and maintain the reactivation of the lesions explains the results obtained in these cases.

Corneal blood vessels may not only cause opacification but necrosis and an actual increase in the amount of corneal infiltration.

The metaherpetic ulcer is probably due to a nutritional disturbance or to some noxious substance brought to the cornea by the abnormal blood vessels. Obliteration of the pericorneal blood vessels is particularly valuable for this condition.

The so-called wandering phlyctenule of the cornea is not always tuberculous in origin. A similar condition may result from herpes corneae and other causes.

Complete peritomy does not cause any visible disturbance in corneal epithelium. Almost all of the pericorneal blood supply can be excluded without harmful effect. In view of this and other experimental evidence cited and in view of the fact that tears are rich in sugar and nitrogenous substances, it is probable that the epithelium derives its nutrients chiefly from the lacrimal secretion and utilizes oxygen directly from the surrounding air.

ABSTRACT OF DISCUSSION

DR. ALBERT D. RUEDEMANN, Cleveland: Vascularization has come to be thought of as a healing process, and it is sometimes difficult to believe that blood vessels themselves may be the cause of most of the pathologic changes so far as the scarring is concerned. I am not so certain but that it might not be advisable in certain instances to stop the progress, even during the active stage. I do not feel that vascularization is always necessary in order to secure good healing. Whenever vascularization begins, scar tissue forms, and scar tissue cannot be

removed. If it were possible to stop the ingrowth of scar tissue from the limbus and to bring the healing process in from the corneal side, then there would be a better chance of obtaining a good clear cornea. It has been my experience in studying the conjunctival capillaries that frequently the deep limbal capillaries will grow up from below and back to the limbus rather than from the limbus to the lesion. In these cases it is not possible to stop the progress of the blood vessels as has been done in cases of lime burn with pseudopterygia. Dr. Gundersen has reported good results in cases in which he has cauterized the vessels rather deeply.

For some time I have felt that if it were possible to decrease the congestion of the ocular conjunctiva in order to limit the amount of blood flowing through the superficial structure of the cornea, the formation of some of these corneal scars might be prevented.

I feel as does Dr. Gundersen, that the healing process followed by vascularization and the formation of scar tissue might be better regulated by cutting out some of the larger vessels. I believe that more scars form during the reparative processes because of a blood vessel, and that if some method is found which will control the formation of blood vessels the amount of scarring might be controlled.

I should like to add one more example of vascularization as a factor in hindering a good result, as exemplified by the filtering operation for glaucoma at the limbus. It has been noted that those patients who have marked vascularization or who have congestion at the time of operation are likely to have a less satisfactory surgical result than those patients who have a noninflammatory, noncongestive or plain chronic simple glaucoma.

I have been studying these problems in the hope of finding out whether the corneal scarring is due to an inhibition to the formation of blood vessels by the aqueous as it filters through the trephine opening or the inclusion opening, whether it is due to stimulation of the formation of blood vessels by the irritation set up at the time of the operation or whether it is due to an irritative aqueous, such as is found in some of the cases of chronic inflammation.

I am certain that those patients who have the best results are those who have the fewest blood vessels at the time of operation, without reaction and without formation of new blood vessels.

Dr. Charles A. Bahn, New Orleans: There are approximately 10,000 people in the United States who are blind from injuries or disease of the cornea. Dr. Gundersen has not presented an improvement in the treatment of some of the conditions which are responsible.

The formation of new blood vessels in the cornea represents a chemical response of a certain character of which but little is known. This formation varies in persons, in diseases and under other conditions. This diversity in the reaction is illustrated in the wide variations of pannus that exist in cases of trachoma.

Owing to the specialization of the cornea, the same blood vessel formation which is essential to healing in most parts of the body sometimes becomes a menace in the cornea. Here, there are two types of newly formed blood vessels, superficial and deep. The superficial grow from the limbal loops, and their purpose is apparently to facilitate

regeneration of the epithelial cells. These new blood vessels, however, may contain noxious substances which not only poison the epithelial cells but also poison more or less permanently focal areas in Bowman's membrane on which the baby epithelial cells grow. These baby epithelial cells are born sick, and they die sick as they advance to the exterior. The areas in which they live are sick areas, and thus there are advancing zones in some corneal conditions, such as marginal ulcerative keratitis, rodent keratitis, wandering phlyctenules, etc. It is possible that this same principle is involved in the formation of pterygia. Vascular obliteration in this group of conditions apparently finds its greatest field of usefulness.

In the deep blood vessels which I believe grow principally from the scleral vessels, the process is apparently different. These blood vessels bring nutritive and protective substances as well as cellular elements to the mesodermic cornea. It is the fibroblasts which they bring that become a menace to healing.

The production of fibroblasts varies with different diseases and in different persons. For example, in cases of vernal conjunctivitis the disease may be present for years with practically no cicatrization, while in some cases of trachoma and of pemphigus cicatrization soon becomes the dominant factor in the tragic picture.

In deep vascularization obliteration is often desirable to reduce cicatrization and possibly delayed healing. In acute infectious ulcers, such as pneumococcic ulcers, vascular obliteration is generally of little value.

Dr. Gundersen's method of using vascular obliteration is superior. The delimiting keratotomy of Gifford largely depends on vascular obliteration. Peritomy is also a more or less crude application of the same principle.

Dr. Gundersen's interesting contribution marks a step forward in the treatment of some corneal diseases that often lead to blindness.

DR. TRYGVE GUNDERSEN, Boston: It must occur to all after hearing this paper that I do not favor the use of vasodilators, particularly ethylmorphine hydrochloride. I have found them ineffective in treating corneal lesions. On the other hand, the use of vasoconstrictors has often been of great value, with the exception of those vasoconstrictors which are followed by a compensatory vasodilatation, such as epinephrine and ephedrine. The value of zinc sulfate in the treatment of many corneal and conjunctival diseases, aside from its action as an antiseptic, may well lie in its effect as an astringent or a vasoconstrictor. An ointment which has been found to be effective at the Massachusetts Eye and Ear Infirmary is an old German preparation consisting of: zinc oxide, 7.8 Gm., or 2 drachms; ichthammol, 0.233 Gm., or 3½ grains; white petrolatum, 23.4 Gm., or 6 drachms. It is important that the ingredients be reduced to a fine impalpable mixture.

CONGENITAL GROUPED PIGMENTATION OF THE RETINA

REPORT OF A CASE

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Congenital grouped pigmentation of the retina presents an uncommon but characteristic ophthalmoscopic picture, which was well described by Stephenson [1] in 1891. This author, in reporting 3 cases, said: "The changes, which occupy a sector-like portion of the fundus, consist of groups made up of black to dark chocolate-brown spots, which, as seen by the direct method, range in size from ½ to 2 mm. or more; in general terms it may be said that the farther the spots lie from the optic disc the larger they become."

A study of the cases reported in the literature shows that the clinical picture of this entity, which has also been called melanosis of the retina and nevoid pigmentation of the fundus, includes certain characteristic findings: 1. The condition is unilateral and more frequent in males than in females. 2. There is no hereditary aspect, and consanguinity does not play a role. 3. There is no association with congenital deformities or with other changes (inflammatory or degenerative) in the fundus or other parts of the eye. 4. The condition is stationary. 5. The fundus is involved in sectors, leaving the macula usually free of lesions. 6. The pigment spots lie deep to the retinal vessels. 7. The visual fields and acuity are not affected. 8. Night blindness is not present in the affected eye.

An early drawing of a typical case is to be found in the atlas of Jaeger,[2] published in 1869. The literature has been thoroughly reviewed by Höeg,[3] Blake,[4] Schieck [5] and Mann.[6] Other authors who have

1. Stephenson, S.: A Peculiar Form of Retinal Pigmentation, Tr. Ophth. Soc. U. Kingdom **11**:77-82, 1891.

2. Jaeger, E.: Ophthalmoskopischer Hand-Atlas, Vienna, 1869, pp. 126-127 and plate XVI, fig. 76.

3. Höeg, N.: Die gruppierte Pigmentation des Augengrundes, Klin. Monatsbl. f. Augenh. **49**:49-77, 1911.

4. Blake, E. M.: Congenital Grouped Pigmentation of the Retina, Tr. Am. Ophth. Soc. **24**:223-233, 1926.

5. Schieck, F.: Die Erkrankungen der Netzhaut, in von Schieck, F., and Brückner, A.: Kurzes Handbuch der Ophthalmologie, Berlin, Julius Springer, 1930, vol. 5, pp. 588-590.

6. Mann, W. A., Jr.: Grouped Pigmentation of the Retina, Arch. Ophth. **8**:66-71 (July) 1932.

reported cases or have discussed the condition include Jacobi,[7] Dodd,[8] Parsons,[9] Chance,[10] Leber,[11] Kraupa,[12] Hedde,[13] Holm,[14] Collins and Mayou,[15] Bedell [16] and Ida Mann.[17]

I am unable to find a report of the microscopic study of an involved eye. The lesion may be due, as Ida Mann has suggested, to localized patches of pigment developing abnormally in the inner layer of the optic cup or to localized proliferations of the pigment epithelium forming the outer layer of the optic cup.

The condition must be distinguished from congenital solitary pigment masses in the fundus and from the patches of pigment following inflammatory and vascular disease of the eye.

Appearance of right fundus, showing congenital grouped pigmentation of the retina.

Although many cases have been described, the extent of involvement of the fundus in the case reported here makes it worthy of record in the literature.

REPORT OF CASE

M. S., a 4 year old asthmatic Jewish boy, was brought to the Vanderbilt Clinic in November 1933, because of symptoms due to mild conjunctivitis. Examination under cycloplegia with atropine showed vision of 20/30— and hypermetropia of 2 diopters. The right fundus contained many black and dark gray pigmented spots of varying sizes lying beneath the retinal vessels; these spots had well defined rounded or angular margins. The left fundus was normal. The parents had normal fundi.

7. Jacobi, J.: Pigmentmassen in der Retina ohne Störung der Sehfunctionen, Arch. f. Ophth. **14**:144-147, 1868.

8. Dodd, H.: Congenital Pigmentation of the Retina, Tr. Ophth. Soc. U. Kingdom **15**:194, 1895.

(Footnotes continued on next page)

This case was presented before the New York Ophthalmological Society in 1934 (by invitation), as an example of congenital grouped pigmentation of the retina.

The boy was seen again in April 1938, with complaints referable to conjunctivitis. Under cycloplegia with homatropine hydrobromide, vision in each eye was 20/20, the patient accepting in the right eye a + 1.00 sph. combined with a + 0.37 cyl., ax. 170, and in the left eye a + 0.75 sph. The fundi were unchanged as compared with the findings of 1933. The appearance of the pigment spots in the right eye is well depicted in the accompanying photograph of a drawing by M. Quinlan. The visual fields were normal; no scotomas could be plotted to correspond with any of the pigmented lesions.

70 East Sixty-Sixth Street.

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9. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 3, p. 904.

10. Chance, B.: Concerning Two Examples of "A Peculiar Form of Retinal Pigmentation" (Stephenson), Ophth. Rec. **24**:186-188, 1915.

11. Leber, T., in von Graefe, A., and Saemisch, E. T.: Handbuch der gesamten Augenheilkunde, ed. 2, Leipzig, Wilhelm Engelmann, 1916, vol. 7, pp. 2041-2044.

12. Kraupa, E.: Studien über die Melanosis des Augapfels, Arch. f. Augenh. **82**:67-93, 1917; Beiträge zur Morphologie des Augenhintergrundes III, Klin. Monatsbl. f. Augenh. **67**:20-21, 1921.

13. Hedde, C.: Gruppenförmige naevoide Pigmentierung der Netzhaut, Klin. Monatsbl. f. Augenh. **64**:301-306, 1920.

14. Holm, E.: Zwei Fälle von gruppierter Pigmentierung, Klin. Monatsbl. f. Augenh. **67**:451-454, 1921.

15. Collins, E. T., and Mayou, M. S.: Pathology and Bacteriology of the Eye, ed. 2, Philadelphia, P. Blakiston's Son & Co., 1925, p. 27.

16. Bedell, A. J.: Some Anomalies of the Fundus, Tr. Sect. Ophth., A. M. A., 1931, pp. 303-337.

17. Mann, I.: Developmental Abnormalities of the Eye, New York, The Macmillan Company, 1937, pp. 153-154.

RETINAL ARTERIOLAR CHANGES AS PART OF AN INDUCED GENERAL VASOSPASTIC REACTION

EFFECT OF TOBACCO AND COLD

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AND
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Functional vasoconstriction, affecting mainly the arteriolar portion of the vascular system, is now generally conceded to play a major part in the production of the peripheral resistance in cases of essential hypertension. The lack of organic change in the arterioles of some hypertensive patients and the drop in blood pressure often seen after the administration of vasodilating and sedative drugs and after section of the splanchnic and other sympathetic nerves, as well as the marked fluctuations in blood pressure in the same persons at various times, all suggest this to be true.

The generalized narrowing observed ophthalmoscopically of the retinal arterioles of patients with the various forms of diffuse vascular disease associated with hypertension is regarded by many as due to spastic constriction or increased tonus in the arterioles rather than to organic change. The recent measurements of the caliber of the retinal arterioles in health and in disease made by Lobeck [1] show graphically the reduction in caliber which is present in cases of vascular disease and hypertension. With his instrument the average caliber of the retinal arterioles of healthy persons varied between 134 and 88 microns. There was a gradual reduction in caliber in various types of hypertensive disease until in patients with nephrosclerosis associated with retinitis, the caliber varied between 33 and 26 microns.

It occurred to us that ophthalmoscopic examination of the retinal arterioles and measurement of their caliber before and during an induced generalized vasoconstrictive reaction associated with a rise in systemic

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From the Section on Ophthalmology (Dr. Cusick) and the Division of Medicine (Dr. Herrell), the Mayo Clinic.

Abridgment of thesis submitted by Dr. Cusick to the Faculty of the Graduate School of the University of Minnesota in partial fulfilment of the requirements for the degree of M.S. in Ophthalmology.

1. Lobeck, E.: Ueber den Durchmesser der Netzhautgefässe am gesunden und kranken Menschen, Arch. f. Ophth. **136**:434-456 (Feb. 20) 1937.

blood pressure might yield information on three points: (1) whether the arterioles of the retina are supplied with vasomotor nerves, (2) whether these arterioles take part in a vasomotor response to a peripheral or toxic stimulus and (3) whether this response, if it occurs, is in the nature of a generalized narrowing or a localized spastic constriction.

One of us was interested at the time in a group of patients who had an idiosyncrasy to tobacco. After these persons smoked one or two cigarets a reaction occurred which was characterized by a marked rise in the systolic and diastolic blood pressure, an increase in the pulse rate and a drop in the cutaneous temperature of the fingers and toes, indicative of peripheral vasoconstriction. This reaction was much more marked with some brands of cigarets than with others and was not affected by any of the filters commonly used. These patients were all hyperreactors to the cold pressor test of Hines and Brown,[2] and the rise in blood pressure after smoking closely paralleled the rise during the cold pressor test (fig. 1). This condition is by no means rare, as one of us (Herrell) has collected reports of a number of cases during the last year and 2 reports have previously been made dealing with the cases from a medical standpoint.[3]

Five of the patients in this group were subjected to ophthalmoscopic examinations, and measurements of the retinal arterioles were made both before and after smoking, a modified Morgan graticule in a Keeler ophthalmoscope being used. With this method a number of squares are reflected on the retina, each square measuring 100 microns on a side. Measurements were made of the four main arteriolar branches in each eye about ½ disk diameter from the optic nerve head, and the average measurement was then calculated. By this method the average caliber of normal retinal arterioles varied between 50 and 60 microns for the nasal arterioles and between 100 and 120 microns for the temporal arterioles.

On repeated examination of all 5 patients a definite measurable reduction in the caliber of the retinal arterioles was found to take place after smoking. Typical average measurements are given in table 1. The narrowing was generalized rather than localized in any particular arteriole, although it varied in different arteriolar branches and in the two eyes of the same subject. This generalized narrowing of the arterioles was similar to that seen in the early phases of increasing blood

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2. Hines, E. A., Jr., and Brown, G. E.: The Cold Pressor Test for Measuring the Reactibility of the Blood Pressure: Data Concerning Five Hundred and Seventy-One Normal and Hypertensive Subjects, Am. Heart J. **11**:1-9 (Jan.) 1936.

3. Herrell, W. E.: Idiosyncrasy to Tobacco: Report of a Case, Proc. Staff Meet., Mayo Clin. **13**:1-6 (Jan. 5) 1938. Herrell, W. E., and Cusick, P. L.: Vascular and Retinal Abnormalities Following Inhalation of Tobacco Smoke: Preliminary Report, ibid. **13**:273-279 (May 4) 1938.

pressure in the hypertensive toxemia of pregnancy. Localized spastic narrowing, such as is seen in the later phases of the toxemia of pregnancy, was not observed in any case. Photographs of the fundus were made in several cases before and after smoking (fig. 2).

The retinal diastolic pressure of all patients was measured by Baillart's dynamometer before and after smoking. As was to be expected,

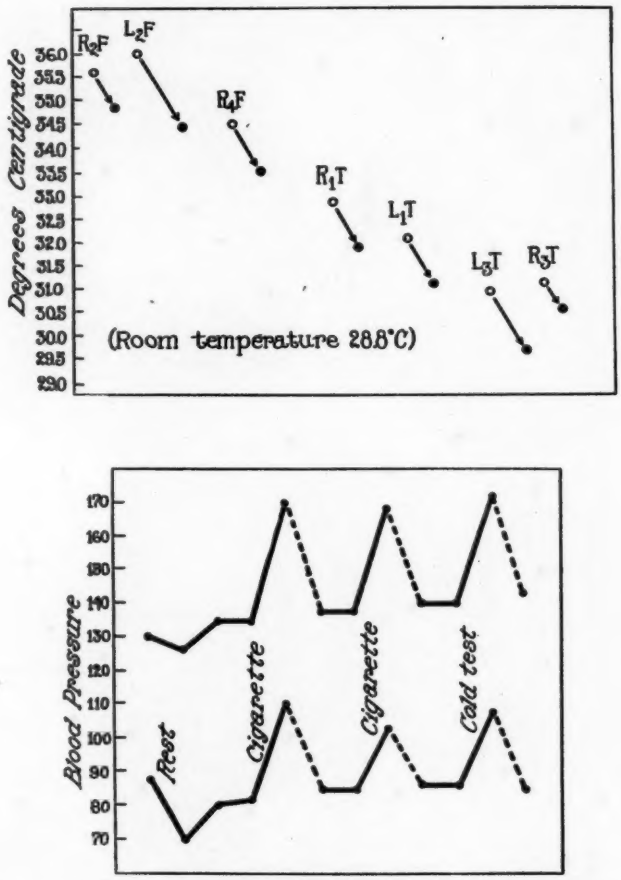

Fig. 1.—The charts showing the cutaneous temperature of the various digits and the blood pressure of a patient with an idiosyncrasy to tobacco before and after smoking a cigaret; also his reaction to the cold pressor test. In the upper chart the cutaneous temperature before smoking a cigaret is indicated by the circle and that after smoking by the black dot.

an elevation of this pressure occurred in all patients proportionate to the elevation in systemic blood pressure. When the retinal diastolic pressure was higher in one eye than in the other, there was, as a rule, a more measurable reduction in caliber in the arterioles of the eye with the higher diastolic pressure. This was particularly true of 1 patient.

Measurements of intraocular tension were made with the Schiötz tonometer for all patients before and after smoking. A slight but definite increase in tension occurred in all 5, the rise varying between 1 and 3 mm. of mercury and averaging 2 mm. This increase appeared to be associated with the increase in intraocular arterial blood pressure. It did not compare directly with the diminution in caliber of the arterioles. The eye with the greater diminution in arteriolar caliber showed at times a lower intraocular tension than the opposite eye.

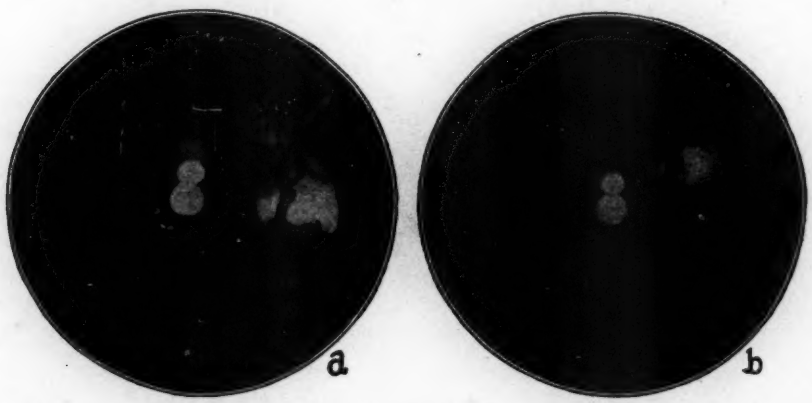

Fig. 2.—The ocular fundus of a patient with an idiosyncrasy to tobacco; *a*, before and *b*, after the smoking of a cigaret.

TABLE 1.—*Average Arteriolar Caliber Before and After Smoking in Patients with an Idiosyncrasy to Tobacco*

Patient	Age, Years	Average Caliber of 8 Arterioles, Microns		Reduction in Caliber, per Cent
		Before Smoking	After Smoking	
1	57	88	72	18.2
2	23	92	68	26.1
3	66	110	88	20.0
4	35	120	90	25.0
5	43	70	56	20.0

Since the vasomotor reaction of the patients who showed an idiosyncrasy to tobacco was similar to that observed with the cold pressor test, an attempt was made to study the changes in the retinal arterioles of subjects undergoing the cold pressor test. In this test, as described by Hines and Brown, a basal level of blood pressure is established by a period of rest and one hand is then immersed up to the wrist in ice water at 4 C. The blood pressure is taken at the end of thirty seconds and again at the end of sixty seconds. The majority of persons show some elevation of both the diastolic and the systolic pressure. Patients

with latent hypertension show a more definite elevation, and patients with established hypertension show a still more marked rise in blood pressure, depending considerably in degree on the severity of the disease. Hines and Brown expressed the belief that this increase in blood pressure was produced by a neurogenic reflex, as the application of a tourniquet above the wrist did not affect the reaction and as they had found that the reaction was also produced in previously adrenalectomized dogs.

Measurements were made of the caliber of the retinal arterioles of 25 patients undergoing the cold pressor test. It was found to be

TABLE 2.—*Changes in the Caliber of the Retinal Arterioles of Persons During the Cold Pressor Test*

Patient	Blood Pressure, Mm. of Hg		Average Caliber of Arterioles, Microns	
	Before Test	During Test	Before Test	During Test
1	130/ 90	150/110	90	68
2	112/ 68	138/ 88	80	72
3	110/ 60	126/ 78	72	60
4	104/ 76	124/ 96	80	66
5	90/ 60	124/ 90	96	76
6	112/ 70	130/ 98	82	72
7	130/ 85	170/110	104	84
8	110/ 68	128/ 96	120	120
9	110/ 70	138/ 94	100	100
10	118/ 70	126/ 98	76	60
11	120/ 80	135/100	84	70
12	92/ 68	118/ 88	70	56
13	150/120	185/140	60	52
14	114/ 72	142/108	74	52
15	110/ 80	120/ 98	82	66
16	110/ 62	130/ 84	90	72
17	110/ 80	115/ 90	104	104
18	116/ 70	168/110	72	52
19	132/ 90	146/105	90	74
20	100/ 64	122/ 88	80	70
21	115/ 82	124/ 84	96	96
22	130/ 95	154/130	58	52
23	120/ 90	130/105	68	68
24	130/ 88	150/112	90	72
25	140/ 90	180/105	90	74

more difficult to make satisfactory measurements for this group of persons than for the former group because of the time element. The blood pressure usually returns rapidly to normal after the hand is removed from the ice water, and, because of the pain occasioned, it is difficult for the patient to keep his hand in the water for more than from one and a half to two minutes. For this reason only two arterioles (the superior and inferior temporal) were measured. Twenty of the 25 patients, however, showed a measurable reduction in arteriolar caliber during the test, the same uniform narrowing being observed as for the patients who were sensitive to tobacco. Three of the 5 remaining patients showed only slight or negligible rise in systemic blood pressure during the test. It is probable that if more arterioles of the other 2 patients had been measured a change would have been noted in some of them, in spite of a rise in blood pressure. The blood pres-

sure readings and arteriolar measurements are shown in table 2. Neither the retinal arterial blood pressure nor the ocular tension was studied for this group of patients.

Of this second group of patients, 19 had basal blood pressures which were considered normal; the retinal arteriolar measurements varied from 70 to 120 microns and averaged 86 microns, which is definitely lower than the normal average. Sixteen of the 19 patients were hyperreactors to the cold pressor test. The finding of retinal arterioles of smaller caliber in this group is interesting because it may furnish additional evidence that these patients had latent hypertension. The caliber of the retinal arterioles of the 2 patients who definitely were not hyperreactors was well within the normal average; the arterioles of 1 patient measured 96 and of the other 104 microns. The 1 remaining patient who showed an average retinal arteriolar caliber of 82 microns was a questionable hyperreactor, his diastolic and systolic pressures both rising 18 mm. of mercury.

The measurements of the retinal arteriolar caliber of the 6 patients with definite hypertension varied between 58 and 90 microns and averaged 76 microns. This agrees with Lobeck's findings that when hypertension is established there is a definite reduction in the retinal arteriolar caliber below the average normal.

SUMMARY

Five patients with an idiosyncrasy to tobacco showed a reduction in caliber of the retinal arterioles after smoking which varied between 18.2 and 26.1 per cent and averaged 20.8 per cent. In 20 of the patients who showed changes in retinal arteriolar caliber during the cold test, the reduction in caliber varied between 10 and 28.6 per cent and averaged 18.6 per cent.

An average rise in intraocular tension of 2 mm. of mercury was noted for the patients who showed a vasospastic reaction from smoking. This rise was variable, however, and it is evident that there was no causative relation between the slight rise in tension and the narrowing of the arterioles.

A rise in the retinal arterial diastolic pressure occurred, as would be expected, with a rise in the systemic blood pressure. One patient with a rather marked variation between the diastolic pressure in the two eyes after smoking showed a more measurable diminution in caliber in the eye with the higher diastolic pressure.

It seems justifiable to conclude from these studies that an elevation in blood pressure induced by the methods employed is associated with a narrowing of the caliber of the peripheral arterioles which also involves the arterioles of the retina. As far as can be judged from ophthalmoscopic appearances, the narrowing of caliber is uniform

throughout the course of any individual arteriole but is not present in equal amounts in all the arterioles. The character of the narrowing suggests that it is due to increased vasomotor tonus rather than to active angiospasm. If our observations on these patients are correct, it seems necessary to assume that the arterioles of the retina are supplied with vasomotor nerves and can undergo active vasoconstriction.

COMMENT

The almost constant association of a transitory reduction in caliber of the retinal arterioles with the rise in systemic blood pressure accompanying the general vasopressor action of cold and tobacco suggests that the generalized narrowing of the retinal arterioles observed ophthalmoscopically in many cases of hypertensive disease (and definitely demonstrated by the measurements of Lobeck) is due primarily to active vasoconstriction or increased vasomotor tonus rather than to actual structural change in the walls of the vessels. This constriction probably occurs through the mechanism of the sympathetic nervous system. If this is true, it would be possible, theoretically, for the caliber of previously narrowed retinal arterioles to increase in hypertensive disease under conditions which would lessen vasopressor stimuli. Such relaxation has been observed clinically in a number of cases in which the systemic blood pressure has fallen after operations on the sympathetic nervous system or after other methods of treatment. The relaxation occurs at times spontaneously in cardiac failure and in other conditions which reduce vasomotor tonus.

HERPES ZOSTER OPHTHALMICUS

REPORT OF A CASE

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Justification for reporting the following typical case of epidemic herpes zoster ophthalmicus lies in the fact that the patient was 5½ years of age. The earliest age at which any patient with this disease had been seen theretofore at the Mayo Clinic was 12 years. The attack occurred on the left side in that instance, and there was no involvement of the nasociliary nerve, nor were there any of the more infrequent complications. It is well known that the disease almost exclusively affects adults, including the aged; however, several cases have been reported in which the patients were children,[1] but it is remarkable how few such reports can be found on search of the literature. This is especially noteworthy when one considers the reported clinical evidence associating herpes zoster with chickenpox.[2]

REPORT OF CASE

A white boy 5 years and 6 months of age, of Irish-American descent, was seen at the clinic and immediately was hospitalized on April 22, 1938, four days after the onset of mild fever, accompanied by several light chills. There was also severe neuralgic pain over the area supplied by the ophthalmic branch of the left trigeminal nerve. This was coincident with the appearance of typically distributed, small, clear, fluid-filled vesicles. There was no history of preceding infection except that a small hordeolum of the left lower lid had appeared twelve days prior to the onset of the herpes. Spontaneous evacuation had occurred, with complete subsidence, four days later. The mother had given the child 20 grains (1.3 Gm.) of acetylsalicylic acid daily for three days before calling a physician; in addition, very hot, moist compresses had been applied almost continuously for the same period over the affected areas.

Dermatologic examination revealed typically demarcated, erythematous herpetic dermatitis with many crusted lesions over the distribution of the ophthalmic branch of the left trigeminal nerve, including the nasociliary branch on that side. The lesions extended only to the midline. There were many large bullae over the frontal region, laterally; they were filled with a dark yellowish, turbid fluid and ruptured in a few hours.

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1. Graves, B., in Berens, C.: The Eye and Its Diseases, Philadelphia, W. B. Saunders Company, 1936, pp. 518-519.

2. Amies, C. R.: The Elementary Bodies of Zoster and Their Serological Relationship to Those of Varicella, Brit. J. Exper. Path. **15**:314-320 (Oct.) 1934.

Ophthalmologic examination was difficult to accomplish because of the marked hyperalgesia, hyperemia and edema of the left upper lid, which overrode the lower lid by 1 cm.; however, retraction revealed the presence, just within the margin of the lid, of three small, true conjunctival herpetic lesions of the palpebral surface of the upper lid in its medial third. There was marked redness and injection of the palpebral and bulbar conjunctiva, and the latter was the site of marked chemosis. The cornea was clear. The anterior chamber was normal in depth, and the pupil was constricted, but round and regular. Other observations could not be made at this time. The right eye was essentially normal throughout.

Daily examination by members of the section on pediatrics revealed nothing remarkable until the fifth day after the patient's admission to the hospital, at which time the generalized vesicular eruptions of a mild attack of varicella manifested themselves. The dermatitis of herpes had improved markedly, and no more bullae had appeared. Ophthalmologically, the right eye was essentially normal throughout except for some mild edema of both lids. Vision was 6/5 without correction; the visual field was roughly normal, and the intraocular tension, determined by means of the Gradle-Schiötz tonometer, was 9 mm. of mercury.

Vision of the left eye was 6/10 without correction; the visual field was roughly normal, and the intraocular tension was 6 mm. of mercury. The margins of the lids once more approximated each other, although considerable mild induration was still present and interfered with full physiologic widening of the palpebral fissure. The palpebral and bulbar conjunctival surfaces remained moderately edematous and injected, and the herpetic bulbar conjunctival ulcers presented necrotic bases. The external ocular movements were normally performed. There was no evidence of intraocular inflammation. Corneal sensitivity was lost. The cornea was clear except for seven small, round areas nasally, of superficial grayish infiltration of the substantia propria. These were typical of herpes zoster keratitis and did not stain with fluorescein. The largest was just less than 3 mm. in diameter. The pupil was now dilated and fixed at 5 mm. Its margin was slightly irregular, and it did not react to any of the usual stimuli; however, it dilated readily and well with 1 per cent solution of homatropine hydrobromide. The anterior chamber was of normal depth, and the media were clear. The fundus was essentially normal to ophthalmoscopic examination except for minimal, generalized, arteriolar narrowing secondary to the mild generalized ischemic pallor of the nerve head. The subjacent retina was slightly edematous, and many fine and small, coalescent, yellowish white exudates were scattered centrally about the macular area except on its temporal side. The exudates were thought to have appeared subsequent to the massive edema of the lids and the orbital tissues.

On the patient's admission to the hospital, an ointment containing 3 per cent ichthammol was applied to the affected areas of the skin, and this was followed, after the first day, by continuous application of calamine lotion packs. Mild protein silver solution, 25 per cent, was instilled three times daily into the left eye. General treatment was begun with the intramuscular injection on the day of admission of 6 cc. of whole blood. This amount was administered daily for five days. The patient remained comfortable under the oral administration of pentobarbital sodium, ¾ grain (0.05 Gm.), twice a day. The temperature began to approach normal on the third day after the child's admission, and such marked improvement took place that he was dismissed from the hospital on the fifteenth day after admission.

Reexamination on May 11, the day of the patient's dismissal from the clinic and one month after the onset of the infection, revealed the cutaneous lesions to be typically well healed. There was no postherpetic neuralgia. The right eye was

normal as before. Vision of the left eye had improved to 6/6 without correction. The residual moderate thickening of the left upper lid had resulted in a temporarily slightly narrowed palpebral fissure, but there was no ptosis and no evidence of damage to the extraocular motor muscles. The pupil still remained dilated and nonreactive except to mydriatics and miotics. There was some mild residual photophobia. The conjunctival lesions had disappeared, and there was only minimal injection of the bulbar conjunctiva. The cornea was still lacking in sensitivity. It was grossly clear, but examination with the corneal microscope revealed the presence of five small, rounded, faint, grayish, superficial areas of infiltration of the substantia propria in the lower nasal quadrant. Ophthalmoscopic examination gave essentially negative results.

Clinical Notes

TREATMENT OF SERPIGINOUS ULCER OF THE CORNEA WITH METHYL SALICYLATE

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In 1929 Sabatzky [1] claimed to have found in methyl salicylate almost a specific remedy for abrasions, ulcers and opacities of the cornea. His method was as follows:

After anesthetization of the eye with cocaine hydrochloride, the foreign body or unhealthy tissue, as the case might be, was scraped off, and a small drop of methyl salicylate was gently rubbed in with a small glass rod. An ointment containing cocaine was then applied, and the eye was covered. Except for the scraping, the treatment was repeated daily until healing was complete. Sabatzky claimed that for years he has been obtaining practically transparent smooth corneas in cases of corneal foreign body, abrasions and ordinary ulcers, and this induced him to try the method in cases of ulcus serpens. The treatment is the same as that previously described, except that the scraped area is treated with a 1 per cent solution of ethylhydrocupreine hydrochloride before the methyl salicylate is rubbed in. Sabatzky treated 24 patients with pneumococcic ulcers, many of them severe, and reported the method entirely satisfactory. The cure is rapid, there is a minimum of corneal change, and good vision is retained. The beneficial effect of methyl salicylate is attributed to the following factors: 1. It has a germicidal action and a capacity to penetrate deeply into the corneal tissue. 2. It is almost a specific corneal tissue regenerator. 3. Its tension-reducing action on the globe sometimes renders the eye so soft as to give one the impression that the globe had been perforated. 4. It has a capacity to clear up existing scars and also to influence newly-forming corneal lamellae in such a way that from the outset no opaque tissue is formed.

Koldovsky-Kvetoslav [2] reported the use of methyl salicylate according to Sabatzky's method in 2 cases of ulcus rotundum, 4 cases of ulcus serpens, 17 cases of infected foci, 2 cases of herpes and 8 cases of catarrhal ulcer. In no case did the defect heal with a transparent cornea and without the appearance of an opacity. The author infected each eye of 5 rabbits with pus from these patients and treated one eye by Sabatzky's method and the other eye with a solution of ethylhydrocupreine hydrochloride or cautery and found Sabatzky's method to be unsatisfactory, as the ulcers spread beyond control. He stated that there is no justification for employing methyl salicylate in treatment and especially not in cases of ulcus serpens, as the pain is intense and better results may be obtained by other methods.

1. Sabatzky, K.: Klin. Monatsbl. f. Augenh. **83**:498 (Oct.-Nov.) 1929.
2. Koldovsky-Kvetoslav, abstracted, Am. J. Ophth. **15**:76 (Jan.) 1932.

Since the publication of Sabatzky's article over 20 cases of the serpiginous type of ulcer of the cornea have been treated at the Montreal General Hospital by the use of methyl salicylate as a cautery. In all except 1 of these cases, in most of which the infection was very severe, in some almost desperate, the results have been most satisfactory; in fact, in some cases they can only be described as magical. In practically all cases bacteriologic examination showed numerous lanceolate gram-positive diplococci in the smears, and in many of the cases further bacteriologic examination verified the presence of pneumococci.

The method employed, which differs somewhat from Sabatzky's, follows:

When it was thought advisable, a bacteriologic examination of the ulcerated corneal tissue was made. The eye was anesthetized with a 1 per cent solution of phenacaine hydrochloride. The ulcerated area was thoroughly dried, and the lids were held away from it by the thumb and the first finger. A round-ended wooden applicator was used to apply the methyl salicylate to the ulcer, the surrounding area being kept dry. The oil was rubbed well into the ulcer. After two or three minutes the eye was bandaged, and the patient was put to bed. The ordinary routine tending to raise the body resistance, such as rest and the use of tonics, was carried out. The application of methyl salicylate was repeated three or four times, which in most cases was sufficient. No other form of cauterization was used.

A description of all of these cases would entail considerable repetition, so three or four, typical of them all, will be reported.

REPORT OF CASES

Case 1.—M. M. C., a man aged 50, was seen in the ophthalmic ward of the Montreal General Hospital with a severe serpiginous ulcer of the right eye. The ulcerated area occupied the lower third of the cornea. There was a large hypopyon present. Smears from the ulcerated area demonstrated gram-positive lanceolate diplococci. I first saw the patient during my rounds of the ward with my associates, and the opinion was then expressed that a Saemisch incision was about the only thing that one could do. I had recently read Sabatzky's article and decided to try his treatment. Methyl salicylate was used as described on three different occasions. There was marked improvement following the first application, and after the third the ulcer was entirely healed. The following statements are taken from the house officer's report: "This patient was seen by me in the surgical outdoor clinic four days ago, with a small ulcer of the right cornea, which the patient stated he had had for some days. The ulcer was cauterized with iodine and the patient instructed to return the following day. He was not seen again until three days later, when examination showed a huge deep ulcer, extending over about one-third the surface of the cornea. It looked as if nothing could possibly save his eye. He was sent into the ward, where the ulcer was cauterized with methyl salicylate. This was done three times in all, and the change was almost unbelievable. Following the first application, the ulcer became noticeably smaller and went on to complete cure. The pain he had complained of soon disappeared, as did the hypopyon." The patient was discharged from hospital cured, after a stay of seventeen days.

Case 2.—M. M., a man aged 61, was seen with a serpiginous ulcer of the right eye, occupying the lower third of the cornea. Hypopyon was present. The ulcer

was cauterized with methyl salicylate. Three days later the hypopyon had entirely disappeared, and the eye had improved in every way. The patient recovered completely.

CASE 3.—W. E., a man aged 61, had a large, deep ulcer of the right cornea at the nasal side. A smear from the ulcerated area showed gram-positive lanceolate diplococci. Cauterization with methyl salicylate was followed in three days by marked improvement. The patient was discharged in two weeks, with the ulcer entirely healed.

CASE 4.—H. T. W., a man aged 72, consulted me at my office in July 1937, when he complained of a painful right eye which had been bothering him for a number of days. Examination showed at the temporal side of the right cornea a vertical, deep ulcer, running from the middle third of the cornea to its lower edge. The ulcer seemed so deep and the eye seemed to be in such a precarious condition that no attempt was made to examine the discharge. I felt that the ulcer could perforate at any minute. Both eyes were bandaged, and the patient was sent to the hospital, where the eye was treated with methyl salicylate. His progress was remarkable, so that he was discharged after two weeks. The vision in the right eye was 6/9, with correction. The patient was recently examined for refraction. It was with considerable difficulty that any scarring of the cornea was made out.

While I was putting these notes together, the following was observed:

R. M. B., a man aged 23, was admitted to the ophthalmic service of the Montreal General Hospital after receiving a perforating wound of the right cornea, which had become infected. Examination showed severe blepharospasm and lacrimation, with severe conjunctival chemosis. A vertical laceration extended through the nasal portion of the visual area of the cornea, from 1 to 2 mm. from either limbus. The line of laceration was filled with exudate, and there was much pus in the anterior chamber. The whole cornea was infiltrated and cloudy. A roentgenogram did not reveal any foreign body. The wound was cauterized with methyl salicylate every third day for four treatments. The wound healed, the hypopyon disappeared after the fourth treatment, and the eye became quiet and healed completely.

In 1 case the result was nil, the methyl salicylate having no beneficial effect. The condition was no different clinically from that in the other cases. The patient, a man, had a severe serpiginous ulcer, with hypopyon. Methyl salicylate was applied three times without effect.

All the patients in this series were of middle age or over, except the patient with the traumatic injury. The ulcers were of the serpiginous type; I have not used methyl salicylate in cases of the catarrhal type of ulcer.

In addition to cauterization with methyl salicylate, all of the patients received other necessary treatment, such as rest in bed, tonics and extra feeding. Ethylhydrocupreine hydrochloride was not used in any case.

The purely empiric nature of this therapy is fully realized; nevertheless, I wish strongly to recommend to my colleagues a therapeutic agent that has proved most satisfactory for this destructive form of ulcer. Unquestionably it is a wonderful remedy in certain cases. It avoids the dense scars of the actual cautery; it has not been found painful, as reported by some. Altogether, I recommend it most highly.

Ophthalmologic Review

ECTOPIA LENTIS

A PATHOLOGIC AND CLINICAL STUDY

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In this paper ectopia lentis and congenital dislocated lenses are considered as synonymous terms for describing all lenses dislocated to a greater or lesser extent (luxations and subluxations) on the basis of developmental anomalies. The justification for adding to the already considerable literature on this relatively rare phenomenon rests mainly on the following points: 1. In view of the confusion surrounding the etiology, an anatomic classification of ectopia lentis has been set up which may help to clarify its clinical study. 2. Histologic observations have been presented which illustrate a form of the ciliary body apparently pathognomonic of ectopia lentis. 3. The largest series of cases of ectopia lentis heretofore reported from one hospital has been analyzed in order to emphasize certain clinical aspects and to evaluate surgical therapy for this condition.

DEFINITION

The early writers did not differentiate between the various types of dislocated lenses. According to Celichowska, who has reviewed the early work, some dislocations, judging from the descriptions, undoubtedly were of the congenital type. For example, the earliest case reported (Berryat, 1749) was that of a young man with both lenses in the anterior chamber, likely the end result of congenital subluxation. The distinction between traumatic and spontaneous dislocation, introduced by Sichel in 1846, advanced the understanding of dislocated lenses. The observation of dislocated lenses in children and in persons who had suffered no known trauma or ocular disease led to the concept of a congenital factor producing the luxation (Arlt, 1849). Since the introduction of the term ectopia lentis by Stellwag in 1856 there has been considerable confusion in the use of terms. Ringelhan and Elschnig's comprehensive review in 1931 presented a rational classification of all types of dislocated lenses, which I believe merits adoption. They divided

Based on a thesis submitted to the Faculty of Medicine, Columbia University, for the degree of Doctor of Medical Science in June 1938.

them into (1) traumatic, (2) *consecutiv* or secondary and (3) congenital dislocated lenses. This classification dispenses with the ambiguous term spontaneous dislocation. The traumatic dislocations are obviously the result of injury. The *consecutiv* dislocations are those which are secondary to ocular disease or degeneration, e. g., iridocyclitis, retinal detachment, tumors, infections, chorioretinitis and hypermature cataracts. As Ringelhan and Elschnig said, the only factor in common in this group is the luxated lens. They expressed the belief that ectopia lentis and congenital dislocated lenses were synonymous terms indicating a developmental anomaly in the position of the lens.

ETIOLOGY

The theories as to etiology are numerous and confusing, which is understandable with a condition based on human embryology and occurring so infrequently as ectopia lentis. No one theory serves to explain all cases of ectopia lentis. Most of the theories have been too narrow in their conception, although the influence of heredity has been admitted by all writers in at least a portion of the cases. Reviews [1] of the various theories have been published, notably those by Celichowska, Péré and Ringelhan and Elschnig, so that only a brief summary is included here.

Among the theories regarding the cause of the congenitally dislocated lens are: fluidity of the vitreous; [2] a morbid process occurring in the suspensory ligament similar to that causing cataract (Jäger); absence of the zonule (Klein); incomplete development of the zonule based on intrauterine infection (Sous); rupture of the zonule due to smallness of the lens (Schirmer); malformation of the suspensory ligament resulting from perivasculitis of the small anterior branches of the hyaloid artery and of the vascular capsule of the lens (Vassaux); impeded development of the lens and the suspensory ligament from mesodermal bands and remnants of the hyaloid artery present during the early months of embryonic life but not evident at birth (Hess); atypical direction taken by the invagination of the lens vesicle; [3] stricture of the amnion interfering with the ocular vesicle (Van Duyse), and ectodermal defects resulting from anomalies in the lens anlage itself (Waardenburg). One of the favorite theories is that of Badal and Lagrange, who expressed the belief that the dislocation is due to the anteroposterior elongation of the globe occurring in myopia. The impor-

1. de Caralt; D'Oench; Pires; Pittenger.
2. von Graefe; Desmarres.
3. Helmholtz; Löwe; Samelsohn.

tant Stellwag-Becker theory, which has been supported by Celichowska and others, is that the defect of the zonule occurs as a result of imperfect or delayed closure of the fetal cleft.

Speculation regarding the etiology has been raised by the reports of other congenital anomalies associated with ectopia lentis. Pupillary membrane (Coats) and corectopia [4] are the most frequently associated anomalies. Other associated bulbar anomalies are microphthalmos (case 31), buphthalmos,[5] megalocornea (Thaden), microphakia,[6] coloboma of the lens,[7] coloboma of the iris,[8] and coloboma of the choroid [9] and optic nerve (fig. 1, globe 1158). The recent work on arachnodactylia [10] has brought to light the fact that dislocated lenses and congenital constitu-

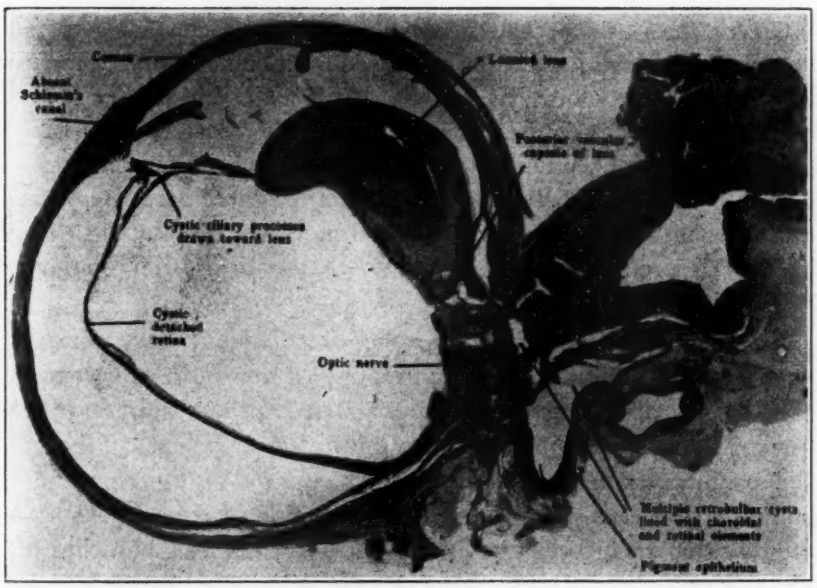

Fig. 1 (globe 1158).—Microphthalmic eye removed from a 10 week old girl. The globe measured 10 by 12 mm. The polycystic mass at the posterior pole shows tissues continuous with the interior of the eye (choroid and retina). The lens is luxated posteriorly by the involvement of its posterior vascular capsule in the cystic mass. The ciliary body on the side opposite to the lens is cystic and drawn backward by fibrous strands. On the side of the lens the ciliary body is nearly absent with a few short ciliary processes; also the angle is rudimentary and Schlemm's canal is missing. The retina also is cystic.

4. de Caralt; Coats; Dixon; Hossmann; Schwarz; Spicer.
5. Allport and Smith; Kurz; Marlow; Péré.
6. D'Oench, 1881; Lindner.
7. Gehrung; Giri; Mann, 1934; Péré; Satanowsky; Weilder.
8. Clark; Guzmann; Kredbova.
9. Addario; Kurz; Wintersteiner.
10. Burch; Isnel and Hakami; Kurz; Lloyd; Morard.

tional defects are more frequently associated than was previously thought. In his excellent review of the Marfan syndrome Burch said that ectopia lentis is found in about one half of the cases of arachnodactylia. Attempts have been made to establish an etiologic relationship between ectopia lentis and these bulbar and constitutional anomalies.

The most recent and perhaps the most authoritative opinion regarding the etiology of ectopia lentis is that of Ida Mann (1937). She regarded the defect as a "dislocation of structures rather than failure." She also said:

> There is no evidence of primary abnormality of any structure but the zonule, in spite of the fact that persistent pupillary membrane and other anomalies of the iris accompany it. [This primary abnormality of the zonule she regarded as an irregular development] with regard to strength and length of fibers, so that when the ciliary ring opens out and should leave the lens suspended in the center of the developing pupil, the lens may show a displacement to one or other side. That this displacement should be more often upwards than in other positions, and very rarely indeed downwards, lends support to this theory, since if the zonule fibres are going to fail they are more likely to do so in the lower part which (being the unstable region of the fissure) is always most likely to show underdevelopment. In such a case the lens would be dragged upwards by the relatively greater pull of the normal fibres at the top. This fits in also with the fact that growth potencies are greatest at the rim of the optic cup at its upper part and its gradients run downwards round the margin towards the fissure.
>
> It is not always justifiable to take refuge in the old theory of persistent mesoderm as an explanation of eye abnormalities. In the case of ectopia lentis we may say that, since it is hereditary (in the same way as certain other admittedly ectodermal abnormalities), it is due to a defect in the tertiary vitreous fibrils at some part of the ciliary ring. It therefore probably begins about the end of the third month, but its potentiality is obviously present from the beginning since it is germinal.

To illustrate the unsettled state as to the causation of ectopia lentis, another recent authority, Duke-Elder, is quoted. In contrast to Mann's opinion that ectopia lentis is due to an ectodermal defect primary in the zonule, he stated:

> The most common cause of an ectopia lentis is a mesodermal aberration; the ætiology of the condition is unknown—presumably it is due to some deleterious chemical influence acting at an early embryonic stage which inhibits mesodermal development, not only in the eye but widely over the body.

In a search for an etiologic basis for ectopia lentis, which by definition is a developmental anomaly, all the factors influencing the development of the embryo must be considered. In a general sense, the anatomic variations from the normal, which are termed congenital anomalies, can be regarded as the resultant of the mutual influence of prenatal environment and hereditary characteristics. The complexities of a study of the etiology of a developmental anomaly are self evident when one even speculates on the countless factors involved in prenatal environment and heredity (Duke-Elder).

HEREDITY

Evidence of the important role played by germinal factors in ectopia lentis has been compiled in Julia Bell's comprehensive review and further confirmed by numerous pedigrees,[11] a partial collection of which was made by Usher. The symmetry and bilateral occurrence of dislocated lenses and the frequency of their occurrence in siblings and in successive generations are strong arguments for the influence of heredity. Pedigrees are on record in which ectopia lentis has appeared in several generations (Pittenger, five generations; Lewis, six generations). According to Mann (1937), "In some families the defect appears almost exclusively in the females; in other families in the males. In others again there is no sex preponderance." The condition may be transmitted by either father or mother to either daughters or sons. While Francheschetti and Díaz-Caneja regarded ectopia lentis as a recessive characteristic because they found consanguinity in families in which ectopia lentis was present, the hereditary element is considered by most authors [12] as being a dominant characteristic, for the defect is most commonly transmitted by a parent who manifests the defect.

It is obvious, as Ringelhan and Elschnig said, that a hereditary factor cannot be shown in all cases of ectopia lentis. Many times lack of investigation or ignorance of the patient regarding his forebears may explain why hereditary transmission is not recorded. On the other hand, investigation in some cases has revealed no known hereditary factor, so that there must be some sporadic cases.[13] Ringelhan and Elschnig cited 1 case in which the parents of an emmetrope with ectopia lentis were found to have myopia but not ectopia lentis. The complexities of heredity are manifold, but its importance in ectopia lentis seems well established.

CLASSIFICATION

An endeavor is made here to set up a classification of the anatomic features of congenital dislocated lenses, which, as previously stated, are the resultant of the interaction of prenatal environment and heredity. Such a classification is obviously artificial when the preliminary stages of the pathogenesis of the condition are not known. Moreover, this classification is one of degree rather than of kind. It proposes to grade the anatomic features found in ectopia lentis from the less severe, involving only the lens supporting structure itself, through the more severe aberrancies, with their associated bulbar anomalies and constitu-

11. Amsler; Cameron; de Caralt; Decker; Díaz-Caneja; Fecht; Francheschetti; A. R. Gunn; Hossmann; Howell; Kredbova; Lewis; Morton; Mules; Pittenger; Roese; von Rötth.

12. Bell; Duke-Elder; Mann, 1937.

13. Bell; Parsons.

tional features. Such a gradation cannot be mutually exclusive, and there is overlapping between the various grades. However, in view of the confusion surrounding the etiology, this classification does seem to clarify the clinical study of a patient with congenital dislocated lenses. The classification is as follows:

I. *Simple Ectopia Lentis.*—This grade is represented by those cases in which the subluxation is due to a defective supporting structure of the lens, i. e., the zonule and the ciliary body. Except for the dislocation of the lens, these eyes are in other respects grossly normal. Slit lamp examinations [14] have sometimes shown the zonular fibers to be attenuated and few in number on the side opposite to the direction of dislocation.[15] Histologic studies have shown the characteristic ciliary body (discussed later) to be present in this grade as well as in the more severe grades of ectopia lentis.

The theories proposed to explain this defective lens-supporting apparatus have been mentioned previously as being either ectodermal (microphakia; abiosis of zonule) or mesodermal (mesodermal bands; hyaloid vessel remains). Since these postulated preliminary steps are regarded as disappearing before birth, the theories remain theories and clinically the only visible result is the dislocated lens.

II. *Ectopia Lentis Combined with Anomalies of Ocular Dimension (Axial Anomalies).*—This grade refers mainly to the combination of simple ectopia lentis with axial myopia, in accordance with the theory of Badal and Lagrange. However, it also refers to any other bulbar anomalies of dimension, regardless of refraction or etiologic theory, so that microphthalmos and buphthalmos are included along with axial myopia as possibly effecting a secondary attenuation of the lens-supporting structures. In regard to myopia, it is generally recognized that most eyes with ectopia lentis are myopic; but not all are myopic due to axial elongation, for the weakened zonule may allow the lens to assume a more spherical shape (Hess; see also the analysis of refraction), thus creating a lenticular myopia, unrelated to the length of the globe. In other cases the myopia may be largely due to a posterior staphyloma which may not affect the anterior segment and the zonule. Thus in this grade are included only those anomalies of the shape or size of the globe which would indicate a probable effect on the suspensory ligament of the lens.

III. *Ectopia Lentis Combined with Anomalies of Ocular Structure.*—This grade refers to those miscellaneous anomalies of bulbar formation which are found more or less frequently in association with ectopia,

14. Bedell; Erggelet; Fox; Hollós; Meesman; Stein.

15. Duke-Elder; Meesman.

even though the possible etiologic relation is not always apparent. These associated anomalies are: pupillary membrane (Crebbin), corectopia;[16] aniridia;[17] polycoria and coloboma of the iris, of the lens or of the choroid;[18] megalocornea (Duke-Elder); retrobulbar cyst (fig. 1, globe 1158), and coloboma of the globe (globe 1158). The wide variety of these associated anomalies includes defects of both ectodermal and mesodermal primitive germ layers, thus confusing the etiologic issue. But when regarded from a clinical standpoint, they represent a convenient though heterogeneous anatomic group of structural aberrancies found in association with ectopia lentis.

IV. *Ectopia Lentis Associated with Constitutional Anomalies.*—Arachnodactylia [19] is the best known constitutional anomaly in grade IV. Other constitutional syndromes less well studied but also associated with ectopia lentis are: dwarfism (Weill), skeletal deformities (Kurz), congenital heart disease (Strebel) and polydactylism (Díaz-Caneja; also case 31 in the present series).

The temptation to correlate ectopia lentis with a defect of a primitive germ layer becomes even greater in dealing with widespread aberrations in body development. According to Mann (1937), this attempt to place the abnormalities in one germ layer "is not at all necessary when we remember the chromosomal linkages between structures of various germ layers already known to occur."

When associated with these constitutional syndromes, ectopia lentis may fall in any of the preceding classifications. It may, for example, be a simple ectopia lentis associated with arachnodactylia, or in another instance it may be ectopia lentis associated with coloboma of the globe, combined with polydactylism. However, for convenience and clarity, this fourth anatomicoclinical gradation has been set for those instances in which constitutional anomalies are associated with the other types of ectopia lentis.

HISTOLOGIC OBSERVATIONS

In the anatomicoclinical classification and later under the topic of clinical aspects (also in table 6) those congenital anomalies associated clinically with ectopia lentis have been considered. In order to show what the relationship of ectopia lentis to other congenital anomalies is from a pathologic point of view, the collection of globes at the Institute of Ophthalmology of the Presbyterian Hospital was reviewed. The collection, accumulated over the eight year period from 1930 through

16. de Caralt; Crebbin; Dixon; Hossmann; Schwarz; Spicer.

17. Batten; Bergmeister; Halben; Neher; Satanowsky.

18. Addario; Gehrung; Giri; Mann, 1934; Péré; Satanowsky; Weilder; Wintersteiner.

19. Burch; Isnel and Hakami; Kurz; Lloyd; Morard.

1937, includes 645 globes, most of which were enucleated at the institute but some of which were sent in from elsewhere for histologic study. Among these 645 globes, 104 showed 26 different types of congenital anomalies (table 1). The incidence of the particular congenital defect, ectopia lentis, among the 104 eyes with any congenital anomaly is 7, or roughly 7 per cent.

In the collection at the institute there were 18 globes with a dislocated lens (table 2). The dislocation was congenital in type in 7, or 39 per cent; dislocations in the others were classified under injuries.

TABLE 1.—*Classification of Twenty-Six Congenital Anomalies Found Histologically in One Hundred and Four Globes*

Anomaly	No. of Globes	Anomaly	No. of Globes
Subluxation of lens	6	Schwalbe's ring	8
Luxation of lens	1	Thinned sclera (blue sclerotics)	1
Vascular capsule of lens	4	Intrascleral nerve loop	22+
Remains of hyaloid artery	12	Retinal folds	2
Pupillary membrane	5	Coloboma of choroid and optic nerve	1
Iris processes	8	Myopia	13
Iris recess	1	Buphthalmos*	13
Coloboma of iris	3	Microphthalmos	1
Iridodialysis and aniridia*	7	Coloboma of globe	1
Ciliary processes on posterior surface of iris	14	Retrobulbar cysts	1
Cysts of ciliary body and processes	10	Cysts of orbit	3
Pigmentation of pectinate ligament	1	Cartilage in orbit	1
Embryonic filtration angle	1	Cyclops	1

* Part of these anomalies were diagnosed as injuries rather than as congenital anomalies.

TABLE 2.—*Types of Dislocated Lenses in Pathologic Collection*

Type of Dislocation	Number
Subluxation, congenital	6
Luxation, congenital	1
Inversion and recession due to injury	1
Luxation in vitreous due to injury	4
Luxation under conjunctiva due to injury	2
Subluxation due to injury	4
	18

The congenital anomalies found associated in the 7 pathologic specimens with ectopia lentis are listed in table 3.

The reasons for enucleating eyes with ectopia lentis are interesting in illustrating the end results in such eyes. As in any condition except a malignant growth, pain or unsightliness is usually the patient's reason for submitting to enucleation. Pain was probably the predominate cause for removal of 4 eyes with glaucoma and of 1 with iridocyclitis, though a staphyloma in 1 eye and buphthalmos in another added a cosmetic reason. Unsightliness was probably the main reason for enucleation of the other 2 eyes, 1 of which was microphthalmic, and contained a large retrobulbar cyst and another of which had bullous keratitis and degen-

eration of the globe. (In table 8 it will be seen that in the present series of clinical cases the 5 eyes which were enucleated all were glaucomatous.) It is probably significant that of the 18 pathologic specimens with all types of dislocated lenses there was an accompanying glaucoma in 5 eyes, of which 4 had the congenital type of dislocation. This might indicate that ectopia lentis progresses to glaucoma, while in the traumatic dislocations the severe disruption of the eye usually necessitates removal before glaucomatous changes have been established histologically.

The incidence of eyes with ectopia lentis seen at the Vanderbilt Clinic has been estimated (table 4) as being 1:4,000. The incidence in the pathologic collection at the Institute of Ophthalmology is 7 in 645 globes, or approximately 1:100. The seriousness of the condition may be deduced from this comparative incidence: It occurs about forty times more frequently among eyes seriously enough "sick" to be

TABLE 3.—*Congenital Anomalies Associated Histologically with Ectopia Lentis*

Globe No.	Grade	Anomaly
20	II	Subluxation of lens; myopia
818	II	Subluxation of lens; myopia; buphthalmos
948*	I	Subluxation of lens
1013	III	Subluxation of lens; coloboma of iris; buphthalmos
1068*	I	Subluxation of lens; intrascleral nerve loop
1073	I	Subluxation of lens; embryonic filtration angle
1158	IV	Luxation of lens; vascular capsule of lens; coloboma of globe; microphthalmos; retrobulbar cyst; polydactylism

* Globe 948 is from case 25 and globe 1068 from case 12 in the present series of cases.

enucleated than it does among eyes affected with the wide variety of ocular conditions seen in the patients of a large ophthalmic clinic.

PATHOGNOMONIC CILIARY BODY AND PROCESSES

As stated in the introduction of this paper, there is a type of ciliary body apparently pathognomonic of ectopia lentis. It may be described as follows:

The ciliary body characteristic of all types of ectopia lentis is quite small with poorly developed or nearly absent circular muscle fibers, and the ciliary processes are extremely underdeveloped and in section appear to point posteriorly. References to the underdeveloped zonule have occurred previously in the literature. For example, Duke-Elder stated: "In cases of simple uncomplicated ectopia the zonule is absent or poorly developed in the direction opposite to the displacement; and it seems that it is the failure of the zonule which is responsible for the deformity." The characteristic ciliary body has also been described by von Hippel, Seefelder and E. Fuchs and is illustrated by A. Fuchs in his "Atlas der Histopathologie des Auges." Pathologic reports have also been made by Terson and Ask. However, Reese in a personal

communication drew attention to the importance of the posteriorly directed ciliary processes. He was the first to emphasize their probable significance as a pathologic diagnostic point.

In an effort to prove or disprove Reese's theory that such posteriorly directed ciliary processes are present in ectopia lentis and in no other condition, 71 of the 645 globes in the collection at the institute were selected for study. These selected globes included most of those which showed the congenital anomalies listed in table 1 as well as those with all types of dislocations (table 2). In 6 of the 7 globes with ectopia lentis the ciliary body was small and the processes directed posteriorly (fig. 2, globe 948). In the seventh globe (fig. 1, globe 1158) the anomalies were so marked (microphthalmos, coloboma of the globe,

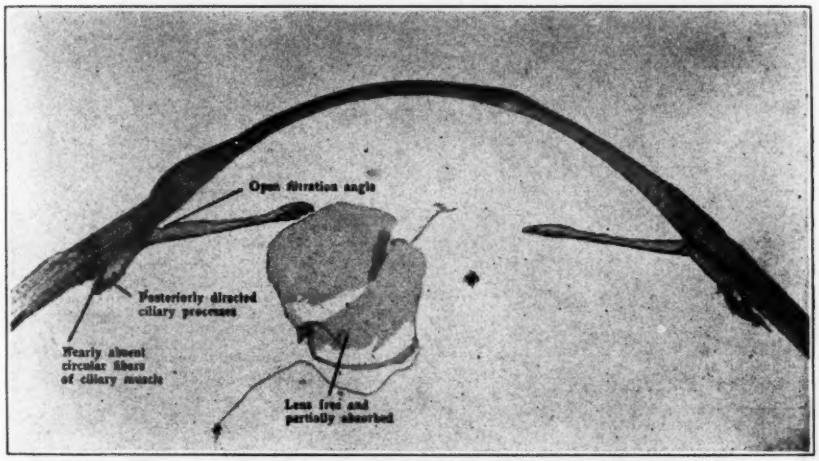
Open filtration angle
Posteriorly directed ciliary processes
Nearly absent circular fibers of ciliary muscle
Lens free and partially absorbed

Fig. 2 (globe 948).—Fairly typical example of the ciliary body and processes in ectopia lentis. The nearly absent circular bundles of ciliary muscle and the small and posteriorly directed ciliary processes are noted. The lens, clinically subluxated, is luxated and partially absorbed in the specimen. Glaucoma was present in this eye, although the filtration angle is open.

and retrobulbar cyst) that the ciliary body had no form at all. There was some slight variation in the size and direction of the ciliary body and processes in the 6 globes (globe 1073), but all fitted into the theory. The converse of the theory also was indicated by the anteriorly directed ciliary processes occurring in traumatic dislocations (globe 532), in myopia (in which the ciliary body was sometimes quite undeveloped) and in the other congenital anomalies listed. The exceptions to the rule were found to be seriously injured eyes in which inflammatory and scar tissue adherent to the ciliary processes had obviously dragged the ciliary processes posteriorly (fig 3, globe 383). The photomicrographs demonstrate these statements, and Reese's hypothesis is confirmed.

INCIDENCE

Ectopia lentis is not a common occurrence, yet it cannot be called rare. The figures on the incidence given in the literature vary considerably.[20] The incidence varies mainly with the type of practice: In a general practice, as represented by all patients seen in the ophthalmic clinic of a hospital, the incidence is much less than that in a consultation practice in which the incidence of all types of pathologic conditions is higher. The figure most quoted is that given by D'Oench, who found 10 cases in 50,000 patients at the Knapp Memorial Hospital. Mooren found 20 eyes (11 patients) with ectopia lentis in 157,359 patients; von Becker, 4 eyes in 11,827 patients; Steffan, 11 eyes in 32,595 patients; Arlt, 8 eyes in 5,525 patients; Péré, 5 cases in 6,700 patients; Celi-

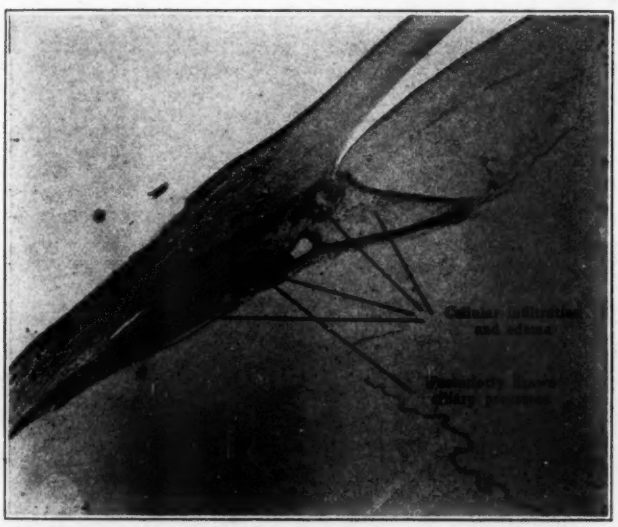

Fig. 3 (globe 383).—Eye with traumatic luxation and detachment of the retina. Inflammatory edema and cellular infiltrate are noted in the filtration angle, iris, scleral spur and ciliary body. The ciliary processes, normal in length, are directed posteriorly due to the traction exerted by the inflammatory process and the detached retina.

chowska 26 cases in 110,000 patients and Ringelhan and Elschnig, 44 eyes in (23 patients) 192,158 patients. Santos Fernández saw only 3 cases in 70,000 patients over a period of forty-three years; Alcalá López observed 2 cases among 8,000 patients in six years, and Miles found 1 case in 10,000 patients.

Of the 31 patients with ectopia lentis in the present series, 11 were seen at the Vanderbilt Clinic over a period of eight years (Jan. 1, 1929 to Jan. 1, 1937), during which time 42,039 new patients were seen.

20. Díaz-Caneja; Dinger; Kurz; Marín Amat; Strebel; Weill.

During the same eight years 18 such patients were seen in Dr. Wheeler's practice; a rough estimate would make the incidence 1:1,000. It is not always clear whether the figures given in the literature refer to eyes or patients. As nearly as these figures can be interpreted, the proportional incidence of cases in the total number of patients is presented (table 4).

TABLE 4.—*Incidence of Ectopia Lentis*

Author	Incidence	Author	Incidence
Alcalá López	1:4,000	Péré	1:1,800
Arit	1:1,800	Ringelhan and Elschnig	1:8,000
Cellchowska	1:4,000	Santos Fernández	1:23,000
D'Oench	1:5,000	Steffan	1:5,000
Grob	1:7,000	Vanderbilt Clinic	1:4,000
Miles	1:10,000	von Becker	1:5,000
Mooren	1:15,000	Wheeler (estimated)	1:1,000

There is a wide variation in the figures. However, a fair average for an ophthalmic clinic of a hospital would be 1:4,000 or 1:5,000.

POSITION OF LENS IN ECTOPIA LENTIS

The position of the lens in ectopia lentis can be examined from two points of view: (1) the direction of dislocation and (2) the degree of dislocation.

The majority of ectopic lenses are dislocated in an upward direction.[21] Because of the possible relationship of this superior dislocation with the fetal cleft (Stellwag-Becker theory), the direction of dislocation has occasioned considerable study. However, lateral and even downward dislocations have been described,[22] so that too much significance cannot be given to the direction of the dislocated lens, though the opinion of Mann (1937) that "the growth potencies are greatest at the rim of the optic cup at its upper part" and therefore the inferior portion of the zonule is likely to be the weaker may be granted. Another point bearing on the direction of dislocation is the influence of senescence and "subclinical" ocular trauma on a congenitally weak zonule. Thus the patients may be of any age (table 5) when seen, and consequently the original direction of dislocation may have been modified by degeneration or injury of the zonule. By this hypothesis, the older the patient the more likely is the direction of dislocation to be downward and the more likely is symmetry of direction in the two eyes to be lacking (father and two daughters: cases 11, 17 and 18).

The degree of dislocation may vary from all types of subluxation to total luxation. Subluxation has been defined (Ringelhan and

21. Dorsch; Mann, 1937.
22. Duke-Elder; Mann, 1937.

Elschnig) as that condition in which the lens remains partially in the hyaloid fossa but is displaced to one side of the optical axis. Luxation, then, would mean complete displacement from the hyaloid fossa.

Partial dislocation or subluxation may be of any degree. It may even be a potential dislocation which manifests itself at a late age or is indicated only by histologic study of the pathognomonic ciliary body (Reese; also case 25 in the present series). Again, it may be so marked that the edge of the lens is visible in the pupil (fig. 4, case 11), and a phakic and aphakic refraction and view of fundi can be obtained [23] with the possible result of monocular diplopia. Or it may be so slight that a barely perceptible iridodonesis or perhaps a slight inequality of the depth of the anterior chamber or astigmatism unexplained by corneal measurement with a keratometer is the only sign.

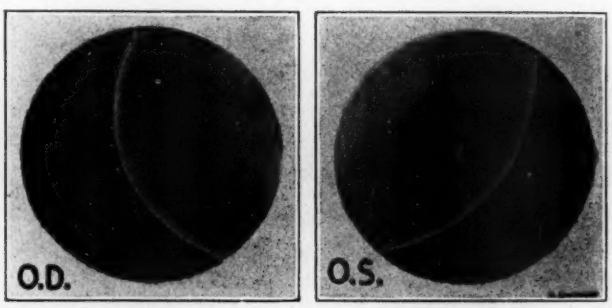

Fig. 4 (case 11).—Ectopia lentis in an Italian married woman aged 27 who had always had poor vision. Her father and two sisters also had ectopia lentis; one brother (not seen) was said to be normal. The drawing shows the upward nasal symmetric subluxation of the lenses as seen through the semidilated pupils. The lenses are clear. The insertion of the attenuated zonule fibers just anterior to the equator may also be noted.

Luxation may be into the vitreous or into the anterior chamber. The zonule may be completely ruptured, or the lens may remain hinged at one point. Such complete displacement from the hyaloid fossa may rarely be the original condition, as when mesodermal bands drag the lens posteriorly into the vitreous.[24] Usually, however, luxation is a result of the transition from a subluxation to complete dislocation occurring either "spontaneously," probably on the basis of senescence or "subclinical" ocular trauma or directly secondary to manifest trauma. In any case the sequelae (especially iridocyclitis and glaucoma) of complete dislocation are manifold and severe.

23. Heddaeus; Leoz; Marquez; Morton; Péré; Williams.
24. Coats; Collins; Kennedy; Seefelder.

CLINICAL ASPECTS

General.—In the usual case of ectopia lentis there are frequently a family history of the condition and bilateral and symmetric subluxation of the lens (fig. 4, case 11). The dislocation is usually upward, but not necessarily so. Phakic refraction usually shows myopia. However, the most important clinical aspect of ectopia lentis is the wide variety of clinical pictures which may be presented. The variability in the direction and the degree of the dislocation has been discussed. The numerous other anomalies, both bulbar and constitutional, which have been shown to accompany ectopia lentis have received consideration in the anatomicoclinical classification previously presented. The frequency of complications in ectopia lentis is another reason for the variable clinical picture. While the emphasis in this paper has been laid on the congenital dislocated lens, it is obvious that in many instances ectopia lentis may be a minor symptom in the individual clinical problem. On the other hand, the detection of an ectopic lens may supply the reason for an acute congestive glaucoma. Again, when corectopia is noted, a realization of its frequent occurrence with ectopia lentis may lead one to detect a barely perceptible iridodonesis.

Diagnosis.—Ordinarily the diagnosis of an ectopic lens is easy. The anterior chamber is deep, the iris and even the lens trembles grossly, the edge of the lens is visible, and the zonular fibers can be seen when the pupil is dilated (fig. 4, case 11). However, when the degree of dislocation is slight, the following points may be of value in establishing the diagnosis. In looking for iridodonesis of slight amount it is better to look midway between the pupil and the periphery for a faint "rippling," similar to that obtained by blowing under a sheet of paper fastened at each end, as the relative rigidity of the pupil and the peripheral attachments are more likely to prevent movement of the inner and outer parts of the iris. Sometimes at examination with the trial case an astigmatism may be found which cannot be explained by the keratometer, or there may be a marked increase of astigmatism from one examination to the next (case 10). Such an event should raise the suspicion of ectopia lentis, although it is not enough to make the diagnosis without corroborative evidence. Another phenomenon which may point toward ectopia lentis is the failure of the pupil to dilate under mydriatics, even atropine[25] (cases 11 and 12). Also, the slit lamp may reveal an anterior chamber of unequal depth which could not be detected grossly, the shallow region being in the direction of dislocation.

Refraction.—The refraction through the lens in cases of ectopia lentis usually shows myopia. It will be shown later in analyzing the cases that the aphakic refraction does not show myopia nearly as fre-

25. Adam; Cameron; Péré.

quently as has been supposed and that therefore this myopia is sometimes lenticular rather than axial. When the pupil, either with or without mydriasis, is divided by the dislocated lens into phakic and aphakic portions, a "double refraction" may be obtained; that is, correction may be made for the refraction through the lens and through the aphakic portion of the pupil.[25] In the same way a duplicated view of the disk may be obtained with the ophthalmoscope.[26] Likewise there may be monocular diplopia or even bilateral quadrantopia.

Amblyopia.—In ectopia lentis the vision, either with phakic or aphakic correction, is frequently so poor that the question of amblyopia is not considered. However, the presence of a relative amblyopia, especially when operative treatment is under consideration, is of great importance in the prognosis (cases 1 and 7). The large refractive error in ectopia lentis, which often cannot be corrected by glasses, or the constantly changing refraction, due to a movable lens, may play a role in establishing amblyopia ex anopsia. Such an amblyopia may even be bilateral,[27] though it is likely to be more marked in one eye. Then, too, strabismus may be present in ectopia lentis, carrying with it the possibility of amblyopia. Sometimes when the distance vision is equally poor in the two eyes, the patient's preference for the eye used for near vision will point toward an amblyopia.

Strabismus.—Squint, both external and internal, has been observed (Cameron; also cases 5, 11, 22, 23 and 29 in the present series). Nonrefractive squint may occur in cases of ectopia lentis presumably just as it may in other ocular conditions. Refractive squint, it might be supposed, would occur more frequently with this condition, with which anisometropia and myopia are so prevalent. The amblyopia accompanying strabismus has already been discussed.

Complications.—Patients with ectopia lentis have defective eyes; the defect may be limited to a weakened zonule and a potential subluxation, or there may be gross displacement of the lens and other anomalies. The point is that these eyes are more susceptible to injury and inflammation than normal eyes. Luxation of the lens, iridocyclitis [28] and glaucoma are the main complications, affecting not only the visual function but the integrity of the eye. Cataract [29] (cases 6, 16, 19 and 29) and detachment of the retina (Díaz-Caneja; also cases 10 and 20 in the present series) are sometimes found also. Luxation rarely may be present at birth but ordinarily it is the result of a sudden

26. Illustration in Morton (after Streatfield).

27. Giri; Horner; Péré; Raab.

28. Hardy; Hine; Howell; Péré; Terren, Cousin and Kalt.

29. Crebbin; Damianos; Díaz-Caneja; D'Oench, 1881; Fox; Péré; Würdemann.

or gradual change from subluxation. The so-called spontaneous luxation is the probable result of many minor insults to a defective eye. Sudden movements of the head or the eye (what has been referred to as "subclinical" trauma) and the degenerative changes of senescence could affect the weak zonule of the eye with ectopia lentis gradually until the lens became free or nearly free from attachments. Blows on the head or jarring falls ("manifest" trauma) might cause a sudden rupture of the attenuated suspensory ligament of the lens. The events following the conversion into luxation would be determined by the suddenness of the onset and by the direction of the luxation. The totally dislocated lens ordinarily would fall back into the vitreous (cases 2, 3, 10 and 21, right eye), but it could also enter the anterior chamber (Bufill; also cases 16, 18 and 21, left eye, in the present series) or even become strangled in the pupil.[30] The vitreous is sometimes able to tolerate the presence of the lens, but usually a mild or severe inflammation is set up, and glaucoma follows sooner or later. Besides the inflammation secondary to luxation, iridocyclitis often develops when the lens is only subluxated. This form of irritation has been considered as due to the constant striking of a movable lens against the ciliary body (Péré). Glaucoma may be secondary to the inflammation, or it may be set up on a mechanical basis. When the pupil is blocked by the lens and usually when the lens enters the anterior chamber, the intraocular circulation is blocked and glaucoma develops. This mechanical type of glaucoma is likely to be acute, with marked pain and congestion. As for the presence of cataract, opinions vary as to its frequency; Ringelhan and Elschnig found opacities of the lens in 28 of 44 cases, while Damianos found the lenses to be clear in 36 of 40 cases.

Prognosis.—The age of the patient, the severity of the ectopia lentis and the presence and type of associated anomalies are necessary considerations in a prognosis as to visual function and to the integrity of the eye. That the age of the patient is important is obvious, for the possibility of complications is greater the longer the life. That a mild degree of ectopia lentis is no guarantee against complications and even loss of the eye is illustrated by case 25, although the onset was delayed until late in life. The eye with ectopia lentis is a "sick" eye, and as such the prognosis is uniformly grave, though the amount of vision, the duration of useful vision and the time of onset of complications are subject to wide variation,[31]

Treatment.—Therapy for ectopia lentis is directed toward the improvement of vision and the preservation of the globe through the prevention or amelioration of complications. Correction of the refrac-

30. Miles; Ringelham and Elschnig.

31. Celichowska; Foxonet; Pittenger; Putman.

tive errors by glasses is the first step. As has been discussed previously, this correction may be phakic or aphakic, depending on the individual factors. Sometimes the daily use of a mild mydriatic enables a useful portion of the pupil to be exposed (case 13). The patient's regimen must be regulated so that trauma will be reduced to a minimum (de Caralt). Careful, frequent and persistent observation of the patient is necessary to detect and treat complications at their inception.

Operative Treatment.—In operative treatment, too, the primary motive is improvement of visual function. In some cases correction with glasses is insufficient or the lenticular myopia is too high or the position or movability of the lens prevents the formation of a clear retinal image. The general attitude toward operation in such cases of ectopia lentis is one of considerable pessimism.[32] The technical difficulties and the higher incidence of serious surgical sequelae are sufficient explanation for this pessimism, though the surgical-mindedness and dexterity of the ophthalmologist may play a role in his attitude. Certainly one would not rush into an operation on a dislocated lens, but when a low visual acuity justifies operation the added risk should not deter the surgeon from attempting to improve such an important function as vision.[33] Further justification may be found in the frequency and severity of complications, some of which might be forestalled by operation. In view of the variability of the clinical picture in ectopia lentis, the feasibility of operation must, of course, be determined by the factors involved in the individual case.

Types of Operation.—The operations which have been described in the literature fall into two groups: operations on the iris and operations on the lens. Operations on the iris are for the purpose of changing the size or position of the pupil so that diffraction and astigmatism of the dislocated lens may be reduced. Iridodesis,[34] that is, a pulling of the iris to one side as in an iridotasis, is done so as to place the pupil more nearly over the center of the lens. This procedure is now seldom mentioned and was never used much. Sphincterectomy, iridotomy and iridectomy[35] are for the purpose of widening the pupil, so that the center of the lens may be more fully exposed or so that an adequate aphakic portion of the pupil may be used. All operations on the iris are not satisfactory and at best are only palliative, since they do not attack the source of the trouble, i. e., the dislocated lens.

Operations on the lens are for the purpose of removing the lens from the visual axis. The oldest of these is couching. Although this procedure has been practically abandoned for cataract, it is still recom-

32. Brazeau; Leoz; Roese; Terrien.
33. Goldenburg; Weeks.
34. D'Oench, 1881; Péré.
35. D'Oench, 1881; Howell; Péré; Ringelhan and Elschnig.

mended occasionally for the treatment of ectopia lentis. Elliot's monograph on couching would seem authoritative opposition to this procedure, even though occasional cases are seen in which the lens is tolerated in the vitreous (cases 2 and 21, right eye). Discission [36] or capsulotomy is probably recommended more often than any other procedure for ectopia lentis. Since the immediate dangers attending discission are small, it would seem to be the most conservative measure to adopt. However, the objection to discission is its frequent ineffectiveness when one is dealing with subluxated lenses. Some peculiar characteristic of ectopic lenses has been suggested (Reese) as preventing good absorption (fig. 5; case 11, right eye). The more usual explanation is the technical difficulty of getting an adequate opening in the capsule of the movable

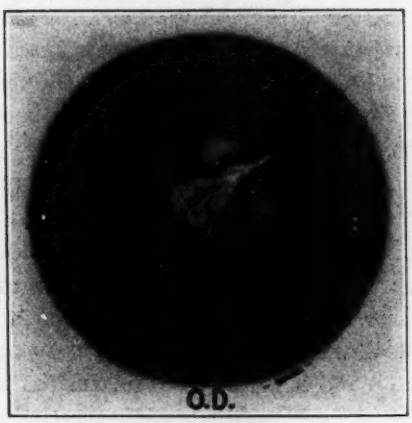

Fig. 5 (case 11).—Incomplete dilation of the thoroughly atropinized pupil (right eye). The poor absorption of the needled lens is clearly shown. Only a small extruded portion of cortex became opaque.

lens. To overcome this, some authors advise the use of two needles, one to fix the lens and the other to tear the capsule.[37]

Extraction is feared by most authors because of the added risk and the technical difficulties. The operative results of extraction reported by Ringelhan and Elschnig and those in the series of cases analyzed here tend to improve the outlook for extraction in cases of ectopia lentis. These results are significant since these two series are larger than any others reported and extraction was employed more often. Ringelhan and Elschnig expressed a preference for intracapsular extraction without iridectomy with the use of the Liegard suture. In the

36. Butler; Decker; Howell; Jackson; Lambert; Morris and Oliver; Péré; Spiece; Strickler; Török and Grout; Weeks; Wray; Zentmayer.

37. Driver; Hine; Horner and Maisler; Parson.

present series the most satisfactory procedure was found to be a wide preliminary iridectomy followed two or more months later by a loop extraction of the lens, conjunctival sutures being employed.

The justification of extraction rests on the fact that the primary cause of the poor vision is removed and the possibilities of future complications inherent in a dislocated lens are diminished. While no universal rule can be laid down for such a variable condition as ectopia lentis, operative intervention is certainly justified in some cases, either to improve vision or to prevent a lens from becoming totally luxated. The added risk of extraction must be balanced against the possible gains, in the calculation of which the presence of amblyopia must be considered. Also, the eventually grave prognosis of the untreated eye with ectopia lentis must be kept in mind.

The operative treatment for the complications is outside the scope of this paper. The treatment for the glaucoma rests with the individual case and the individual surgeon. Luxation of the lens into the anterior chamber bears mention, however, for usually an acute congestive glaucoma results which needs emergency treatment (case 18). Nonoperative treatment in such cases is poor treatment, for it is not effective, and, besides, the presence of the lens in the anterior chamber furnishes an excellent opportunity for its removal. Extraction of a lens from the anterior chamber is relatively easy, if the lens can be made to stay there. Strong miotics to close the pupil behind the lens, fixation of the lens with a needle or extraction with the patient in the prone position (Luedde; also cases 18 and 21 in the present series) are various ways of obtaining this.

DATA FROM THIRTY-ONE CASE HISTORIES

Thirty-one cases from the records of the Presbyterian Hospital are analyzed here. Eleven of the patients entered the hospital from the Vanderbilt Clinic, 18 from the practice of Dr. John M. Wheeler and 1 each from the practices of Dr. John Dunnington and Dr. Hugh McKeown.

The sex ratio is not valuable in such a small series: There were about one and one-half as many males as females.

The ages at which the 31 patients were seen in this hospital are given in table 5. The youngest patient seen was 6 months old; the oldest was 71 years. While many of these patients were seen elsewhere and a diagnosis was made, this table shows a fairly even age distribution of the patients who present themselves for treatment.

A family history of ectopia lentis was obtained for 6 patients, representing three families (cases 11, 16, 17, 18, 26 and 27).

The congenital anomalies found in association with ectopia lentis are recorded in table 6.

Strabismus was present in 5 cases: exotropia and left hypertropia in 1 case, exotropia in 3 cases and esotropia in 1 case. This high incidence of 20 per cent is suggestive, but of course not conclusive in such a small series.

There was glaucoma in 12 eyes of 10 patients, 10 of these being eyes not operated on for improvement of vision. The other 2 eyes with glaucoma were subjected to extractions and were thereby relieved of the glaucoma.

TABLE 5.—*Age Distribution*

Age in Years	No of Patients
1- 4	4
5- 9	4
10-14	3
15-19	1
20-24	3
25-29	3
30-34	3
35-39	0
40-44	0
45-49	2
50-54	2
55-59	3
60-64	1
65-69	1
70-75	1
	31

TABLE 6.—*Congenital Anomalies Associated Clinically with Ectopia Lentis*

Anomalies	Eyes	Patients
Pupillary membrane	7	4
Corectopia	4	2
Heterochromia iridis	1	1
Atrophy of iris	2	1
Poor dilation of pupil	4	2
Coloboma of choroid and iris	1	1
Aniridia and nystagmus	3	2
Cataract	10	6
Coloboma of lens	4	2
Posterior staphyloma	3	3
Microphthalmos	1	1
Polydactylism	..	1

Detachment of the retina occurred in 2 eyes, and in another instance it followed preliminary iridectomy.

Macular degeneration was found in 1 patient.

The anatomicoclinical classification previously presented is applied to this series of cases: grade I, 19 eyes; grade II, 23 eyes; grade III, 12 eyes, and grade IV, 1 eye. Seven were unclassified, owing to insufficient data.

The refraction is known for 35 eyes: The phakic correction was made for 19 eyes, the aphakic correction for 22 eyes and both the aphakic and the phakic correction for 6 eyes. The phakic correction for 17 of the 19 eyes was for myopia; for 1, for emmetropia, and for the other,

for mixed astigmatism. In considering the refraction of the aphakic eyes, all those eyes having a correction of less than +10 D. are considered as having axial myopia, those above +11 D. as being hyperopic, while a few fall into a borderline classification. On this basis, 10 of the 22 aphakic eyes were myopic, 6 were hyperopic and 5 fell into a borderline classification. The greater prevalence of myopia in the phakic correction would corroborate the supposition that a great deal of the myopia in ectopia lentis is on the basis of lenticular myopia. However, the aphakic refractions show that axial myopia is present in about half the cases.

The comparative results of surgical and nonsurgical treatment and of the different types of operations are now considered. In table 7 the number of eyes which were not operated on to improve vision as well as the number which underwent the various types of operations for visual improvement are listed.

TABLE 7.—*Operative Therapy for Present Series of Cases*

Treatment	No. of Eyes
No operation done to improve vision (i. e., needling, preliminary iridectomy or extraction)	41
Needling (2 other needled eyes operated on are listed later)	3
Preliminary iridectomy without extraction	3
Extraction from anterior chamber without iridectomy	2
Extraction with iridectomy	2
Extraction without iridectomy	1
Extraction after iridectomy	10
	62

For the 41 eyes which were not subjected to an operation to improve vision, i. e., preliminary iridectomy, needling or extraction, the possible seriousness of the outcome can be gathered from table 8.

From table 8 it is seen that of the 41 eyes not operated on for visual improvement, glaucoma was present in 10 (5 of which were enucleated), detachment of the retina in 2 and phthisis bulbi in 1. Luxation was present in 9 of these eyes, combined with glaucoma in 6 and with detachment of the retina in 1. Only 2 of the 9 eyes with luxation were useful eyes. The high incidence of glaucoma in cases of ectopia lentis in which operation was not performed is shown, being approximately 25 per cent. Table 8 also shows the high incidence of luxation (about 22 per cent) with its accompanying serious complications.

Of the 21 eyes that were operated on to improve vision, serious results occurred in 3: Hypotony and detachment of the retina developed in 1 after preliminary iridectomy; hemorrhage and prolapse of the iris followed a simple extraction in another; choroidal detachment and iridocyclitis occurred after a combined extraction in the third eye. The details of the various types of operations are given in table 9.

TABLE 8.—*Synopsis of Data on Forty-One Eyes Not Operated on for Visual Improvement*

Case	Age	Eye	Complications	Best Vision*	Operation
2	52	O. D.	Lens in vitreous; posterior staphyloma	20/20	
		O. S.	Glaucoma; luxation in vitreous and anterior chamber	C. F.	Iridectomy for glaucoma
3	27	O. D.	Glaucoma	Nil	Enucleation
		O. S.	Aniridia; nystagmus; glaucoma; luxation in vitreous	C. F.	
4	4+	O. D.		20/200	
		O. S.		15/200	
7	56	O. D.	Glaucoma	Nil	Enucleation
8	10	O. D.	Amblyopia	20/70	
		O. S.		20/40—2	
9	8	O. D.		10/200	
		O. S.		20/200	
10	53	O. D.	Detachment of retina; luxation in vitreous	H. M.	
11	27	O. S.	Poor dilation of pupil; exotropia	20/100+1	
12	2	O. D.	Keratitis; glaucoma; poor dilation of pupil	H. M.	Enucleation
		O. S.	Hinged luxation; glaucoma; amblyopia; poor dilation	20/70—1	Trephine with iridectomy
13	46	O. D.	Luxation; glaucoma	Nil	Enucleation
		O. S.	Contracted field	20/40	
15	23	O. D.	Aniridia; nystagmus; luxation; glaucoma	Nil	
		O. S.	Aniridia; nystagmus	C. F.	
16	56	O. D.	Luxation in anterior chamber; cataract; glaucoma; aniridia (?)	H. M.	
		O. S.	Phthisis bulbi	L. P.	
17	12	O. D.		20/40+1	
19	71	O. S.	Cataract	20/20	
20	31	O. D.	Heterochromia iridis; posterior staphyloma	20/50	
		O. S.	Detachment of retina	L. P.	
21	34	O. D.	Luxation in vitreous; atrophy of iris	20/15—	
23	24	O. D.	Exotropia	20/40—	
		O. S.	Exotropia	20/30—	
24	18	O. S.		20/50	
25	60	O. D.	Glaucoma; keratitis	Nil	Enucleation
		O. S.		20/20	
26	7	O. D.	Pupillary membrane	20/100	
		O. S.	Pupillary membrane	20/50	
27	11	O. D.	Coloboma of lens; pupillary membrane	C. F.	
		O. S.	Coloboma of lens; pupillary membrane	20/30+	
28	6	O. D.		20/30—1	
		O. S.		20/30—1	
29	23	O. S.	Exotropia; corectopia	20/40+	
30	7	O. S.	Coloboma of lens; corectopia; pupillary membrane	20/200	
31	6 mo.	O. D.	Microphthalmos; glaucoma; polydactylism; coloboma of iris; coloboma of choroid and optic nerve	Nil (?)	
		O. S.		Normal (?)	

* C. F. indicates ability to count fingers; H. M., perception of hand movements; L. P., perception of light.

From needling, as seen in table 9, only a slight absorption of the lens was obtained. In 2 cases this partial absorption did widen the aphakic portion of the pupil sufficiently to enable an aphakic correction to be used.

From table 10 it is seen that iridectomy in 1 case exposed the pupil sufficiently to give adequate aphakic refraction; vision in 1 eye (case 24, right eye) was lost, though no operative complications furnished an

TABLE 9.—*Synopsis of Data on Five Eyes in Which Needling Was Done*

Case	Eye	Age	Preoperative Vision	Postoperative Vision	Preoperative Complications	Operative and Postoperative Complications
1	O. S.	27	20/50—1 (a)	Unimproved	.....	Little absorption
11	O. D.	27	20/200 (p) 20/200+1 (a) when dilated	200/100+1 (a) not dilated	Exotropia	Needled on 2 occasions; enough absorption to expose aphakic part of pupil (fig. 2)
17	O. S.	12	20/100 (p) 20/40 (a) dilated	20/40 (a) undilated	.....	Enough absorption to expose aphakic part of pupil
22	O. D.	4	4/200 (p)	Unimproved	Esotropia	Almost no absorption
	O. S.	5	5/200 (p)	Unimproved	Lens attached only above; esotropia	Vitreous tag protruded through wound

* (a) indicates aphakic portion of pupil; (p), phakic portion.

TABLE 10.—*Synopsis of Data on Three Eyes in Which Preliminary Iridectomy Was Done*

Case	Eye	Age	Preoperative Vision	Postoperative Vision	Preoperative Complications	Operative and Postoperative Complications
11	O. D.	27	20/100+1 (a)	20/100+1 (a)	2 preceding needlings; exotropia	Sufficient pupil exposed to give adequate aphakic refraction, but still no improvement in vision; amblyopia (?)
18	O. D.	56	20/200	Unimproved	Incipient glaucoma	Slight loss of vitreous; good recovery
24	O. D.	18	C. F. at 1 foot (30 cm.)	L. P.	.....	Hypotony and detachment of retina with no loss of viscid vitreous and reformation of anterior chamber at end of operation

explanation; and in the third case (case 18, right eye) extraction had not yet been done.

The difficulty in the extraction of a lens made accessible by luxation into the anterior chamber is in keeping the lens from falling back. In both of these cases (cases 18 and 21, left eye) the prone position was used to maintain the lens in the anterior chamber. The seriousness of luxation into the anterior chamber is obvious from the poor preoperative vision in both cases and the presence of glaucoma in 1 case and keratitis in the other. Extraction is practically mandatory in such cases and, as indicated by the results in table 11, is justifiable.

It would seem from the 2 cases in table 13 and the 1 in table 12 that incarceration is likely to occur unless the procedure is shortened and the iris controlled by the performance of a preliminary iridectomy.

In this series (table 14) there was loss of vitreous at 5 of 10 preliminary iridectomies and at 7 of 10 extractions after iridectomy.

TABLE 11.—*Synopsis of Data on Two Eyes in Which Extraction Was Done from the Anterior Chamber Without Iridectomy*

Case	Eye	Age	Preoperative Vision	Postoperative Vision	Preoperative Complications	Operative and Postoperative Complications
18	O. S.	56	C. F. at 3 inches (7.5 cm.)	20/50+1	Tension, 38	Lens fell back in vitreous with patient supine; restored to anterior chamber by prone position; loss of vitreous; tension became normal after atropine was stopped
21	O. S.	36	C. F. at 2 feet (61 cm.)	20/30+	Keratitis	Patient operated on in semiprone position; slight loss of viscid vitreous

TABLE 12.—*Synopsis of Data on One Eye in Which Extraction was Done Without Iridectomy (Simple Extraction)*

Case	Eye	Age	Preoperative Vision	Postoperative Vision	Preoperative Complications	Operative and Postoperative Complications
30	O. D.	8	S/200	Faulty l. p.	Coloboma of lens; corectopia up and out; pupillary membrane	Capsule broke; iris incarcerated; pupil drawn up; iridotomy 1 year later followed by hyphema and secondary membrane; trauma led to hyphema and blood-staining of cornea and faulty projection 1 year later

TABLE 13.—*Synopsis of Data on Two Eyes in Which Extraction Was Done With Iridectomy (Combined Extraction)*

Case	Eye	Age	Preoperative Vision	Postoperative Vision	Preoperative Complications	Operative and Postoperative Complications
1	O. D.	26	?	Faulty l. p.	?	Incarceration of iris; good vision immediately after operation; eye became red and painful; choroidal detachment; operation performed in another hospital
29	O. D.	23	C. F. at 3 feet	Unimproved	Exotropia; cataract; corectopia up and out	No loss of vitreous; incarceration of iris; high "hammock" pupil developed which was covered by upper lid

Vitreous was lost from 5 eyes both during the preliminary iridectomy and during the extraction afterward. Yet it will also be noted that incarceration of the iris did not occur. In the 3 eyes in which the vision was unimproved there were no operative or postoperative complications interfering with vision, as indicated by ophthalmoscopic examination

of the media. In 1 of these cases there was macular degeneration; in the other 2 amblyopia may have been the reason for lack of visual improvement. In all the other eyes there was a marked visual gain.

TABLE 14.—*Synopsis of Data on Ten Eyes in Which Extraction was Done After Preliminary Iridectomy*

Case	Eye	Age	Preoperative Vision	Postoperative Vision	Preoperative Complications	Operative and Postoperative Complications
1	O. S.	27	20/50—1 (a)	20/70+ unimproved	Needled previously; small loss of vitreous at iridectomy	Loss of vitreous and hemorrhage into vitreous; discission required; performed without complication
3	O. D.	45	C. F. at 2 feet	20/50—2	Immature cataract; no loss of vitreous at iridectomy; exotropia and left hypertropia	No loss of vitreous
5	O. S.	45	C. F. at 5 feet (152 cm.)	20/20	Immature cataract; exotropia and left hypertropia; no loss of vitreous at iridectomy	No loss of vitreous
6	O. D.	31	4/200	20/30—1	Cataracta caerulea; fluid loss of vitreous at iridectomy	Lens expressed spontaneously; loss of vitreous; vitreous cloudy for a time after operation
6	O. S.	31	20/200	Unimproved	Cataracta caerulea; posterior staphyloma; fluid vitreous at iridectomy	Loss of vitreous; vitreous cloudy for a time; myopic macular degeneration noted after operation when fundus could be adequately seen
7	O. S.	56	20/70	Unimproved	Cataract; vitreous projects into anterior chamber around edge of lens; no loss of vitreous at iridectomy	Small loss of vitreous
10	O. S.	53	6/200	20/70—	Coloboma of lens; some loss of vitreous and small hyphema at iridectomy	Much loss of vitreous; slow recovery; postoperative vision as given was taken only 1 mo. after operation; some opacities of vitreous
14	O. D.	65	1/200	20/40	Nuclear cataract; myopic degeneration of choroid; no loss of vitreous at iridectomy	Slight loss of vitreous
14	O. S.	65	20/200	20/40	Nuclear cataract; myopic degeneration of choroid; no loss of vitreous at iridectomy	No loss of vitreous; rupture of capsule; small hyphema; considerable cortex; discission performed later
19	O. D.	71	4/200	20/30	Senile cataract; loss of fluid vitreous at iridectomy	Loss of vitreous

Of the eyes not operated on for improvement of vision, it will be noted that 22 (53 per cent) are economically blind (20/100 or less). Of the eyes which were operated on for improvement of vision, little or no improvement in vision was obtained after needling or iridectomy (8 eyes), while 9 of 15 eyes subjected to extraction showed improve-

ment of vision postoperatively. Each of 2 eyes showed improvement of vision after extraction of the lens from the anterior chamber, and 7 of 10 eyes showed visual improvement after extraction following preliminary iridectomy, while the results in the 1 case in which simple extraction was done and in the 2 in which combined extractions were done were not so good.

This series, small as it is, would indicate that a more optimistic attitude is justified toward extraction of congenitally dislocated lenses.

SUMMARY AND CONCLUSIONS

A review of the literature, fairly exhaustive since 1920, has been made as well as a study of 71 of the 645 globes in the collection of pathologic specimens of the Institute of Ophthalmology of the Presbyterian Hospital in New York and an analysis of 31 case histories from the records of the Presbyterian Hospital.

Ectopia lentis, synonomously with congenital dislocated lens, is defined as a dislocation of the ocular lens, of greater or less degree, based on a developmental anomaly.

The pathogenesis of ectopia lentis is in a confused state due to many conflicting theories of etiology.

An anatomic classification is proposed to clarify the clinical study of ectopia lentis. It is understood that these gradations are not mutually exclusive, as ordinarily eyes with ectopia lentis will fit into more than one class.

The anatomicoclinical grades are: grade I, simple ectopia lentis; grade II, ectopia lentis combined with anomalies of ocular dimension; grade III, ectopia lentis combined with anomalies of ocular structure; grade IV, ectopia lentis combined with anomalies of constitution, i. e., aberrancies of body development.

Pathognomonic of ecotpia lentis are a poorly developed ciliary body and ciliary processes which are small and point posteriorly, as revealed in histologic specimens.

Amblyopia is frequently present, sometimes in both eyes, and is an important consideration in postoperative prognosis.

There is a high incidence of strabismus.

Phakic refraction nearly always shows myopia (90 per cent). With aphakic refraction, relative myopia is less frequent (45 per cent) but more common than hyperopia (32 per cent) or a borderline condition (23 per cent). This would indicate that a good deal of the myopia in cases of ectopia lentis is lenticular rather than axial.

The ultimate prognosis for untreated eyes with ectopia lentis is bad.

Discissions and operations on the iris are usually unsatisfactory.

Skilful loop extraction following a wide preliminary iridectomy offers the best solution of a difficult problem.

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News and Notes

GENERAL NEWS

Postgraduate Course.—A postgraduate course in ophthalmology will be given at the Center for Continuation Study at the University of Minnesota, Jan. 16 to 21, 1939. The course is recommended primarily for ophthalmologists, but all physicians are invited to attend. Physicians residing outside the state are accepted on the same basis as those living in Minnesota. The subject matter will be presented in the form of illustrated lectures, movies, demonstrations and round table question and answer periods. Clinics will not be attempted because of the difficulty in showing patients properly to more than a few physicians at a time. The regular faculty will be augmented by the following guest speakers: Dr. William Thornwall Davis, Washington, D. C.; Dr. Sanford Gifford, Chicago; Dr. Harry S. Gradle, Chicago, and Dr. Albert D. Ruedemann, Cleveland.

The fee for the course is $25. Further information can be obtained from Dr. William A. O'Brien, director of postgraduate medical education, University of Minnesota, Minneapolis, Minn.

Course in Ophthalmology, Harvard University Medical School.—Harvard University Medical School offers the following courses in ophthalmology for the first half of 1939:

From February 6 to 18 a course on ocular muscles will be given. This course includes the neuroanatomy and physiology of the ocular muscles as an introduction to didactic and clinical work and deals extensively with vertical deviations. It does not include orthoptics. The course is given by Drs. Bielschowsky and Casten.

From March 1 to 31 a course on the use of the slit lamp will be given by Dr. Beetham; a course on external diseases of the eye by Dr. Gundersen, and a course on ocular complications in general disease by Dr. King. These courses may be taken simultaneously.

From April 10 to May 6 a course in recent advances in ophthalmology will be given. This course correlates the pathology of the eye and clinical practice. It draws on all resources of the ophthalmic department of the Massachusetts Eye and Ear Infirmary, clinical, laboratory and research. Although this course has pathology as a basis, it gives a cross section of all work at the infirmary. The section on pathology is given by Dr. Terry.

In July a course on visual optics and physiology will be given by Drs. Ludvigh, Cogan and Easton.

Beginners and general practitioners may take the course in ocular complications in general disease. All other courses listed are not open to beginners. Further information may be obtained from the assistant dean of the medical School.

Annual Course, Research Study Club of Los Angeles.—The eighth annual midwinter clinical course will be given by the Research Study

Club of Los Angeles from January 16 to 27 inclusive. It will embrace both ophthalmology and otolaryngology.

The teaching staff will include: Prof. Gösta Dohlman, professor of otolaryngology, Lund University, Lund, Sweden; Dr. Edward Jackson, emeritus professor of ophthalmology, University of Colorado Medical School, Denver; Dr. John F. Barnhill, emeritus professor of head and neck surgery, University of Indiana, Indianapolis; Dr. William L. Benedict, head of the department and professor of ophthalmology of the Mayo Foundation, Rochester, Minn.; Dr. Phillips Thygeson, assistant professor of ophthalmology of the College of Physicians and Surgeons, Columbia University, New York; Dr. George N. Hosford, ophthalmologist to the Children's Hospital, San Francisco; Dr. Augustus Pohlman, former professor of anatomy, Creighton University Medical School, Omaha; Dr. Simon Jesberg, assistant professor of otolaryngology, University of Southern California, Los Angeles; Dr. Louis K. Guggenheim, assistant professor of otolaryngology, Washington University, St. Louis; research associate, University of California, Los Angeles; director of research in otolaryngology for the Research Study Club of Los Angeles.

Instruction courses in ophthalmology will be given as follows: "Diseases and Disorders of the Orbit: Treatment and Surgery," by Dr. William L. Benedict; "Procedures of Value in the Diagnosis and Management of Ocular Diseases," by Dr. Phillips Thygeson; "Hydrogen Ion Phenomena in Relation to Ophthalmology," by Dr. George N. Hosford; "Practical Methods of Refraction," by Dr. Edward Jackson, and "The Pathology of the Uveal Tract," by Dr. M. N. Beigelman.

American Board of Ophthalmology.—The American Board of Ophthalmology announces an important change in its method of examination of candidates for the board's certificate.

Examinations will be divided into two parts. Candidates whose applications are accepted will be required to pass a written examination, which will be held simultaneously in various cities throughout the country approximately sixty days prior to the date of the oral examination.

The written examination will include all of the subjects previously covered by the practical and oral examinations.

Oral examinations will be held at the time and place of the meeting of the American Medical Association and of the American Academy of Ophthalmology and Otolaryngology and occasionally in connection with other important medical meetings. The oral examination will be on the following subjects: external diseases, ophthalmoscopy, pathology, refraction, ocular motility and practical surgery.

Only those candidates who pass the written examination and who have presented satisfactory case reports will be permitted to appear for the oral examination.

Examinations scheduled for 1939 are as follows: written examinations, March 15 and August 5; oral examination, May 15 in St. Louis and October 6 in Chicago.

Applications for permission to take the written examination on March 15 must be filed with the secretary not later than February 15.

Application forms and detailed information should be secured at once from the secretary, Dr. John Green, 6830 Waterman Avenue, St. Louis.

Anniversary Number of Annales d'oculistique.—The January 1938 number of the *Annales d'oculistique* is devoted to a celebration of the hundredth anniversary of the journal. The *Annales* was originally a Belgian publication, founded by Cunier in 1838, and has always been conducted by a French and Belgian editorial board.

The foreword written by Cunier for the first number of this periodical in 1838 and the table of contents of the first volume are reissued. Then follows an article by Rochon-Duvigneaud, in which he reviews one hundred years of French and Belgian ophthalmology, with seventeen excellent photographs of outstanding French and Belgian ophthalmologists. Some old papers which are characteristic of their eminent authors are reprinted: "Paralysis of the Associated Ocular Movements," by Parinaud in 1883; "Sclerotomy," by Lagrange in 1906; "Vision," by Nuel, with an analysis of the article by Parinaud in 1904; "Gonorrheal Infections," by Morax, and "Laqueur's Discovery of the Antiglaucomatous Action of Eserin," by Redslob in 1876.

The editorial board of the present *Annales* consists of Magitot, chief editor; Rochon-Duvigneaud, Bailliart, Hartmann, Leplat, Dupuy-Dutemps, Redslob, Jeandelize and Hambresin.

Theodore Axenfeld Prize.—The publishing firm, Ferdinand Enke Verlag, in Stuttgart, Germany, has decided to donate a Theodore Axenfeld Prize. This prize of 500 reichsmarks will be distributed every two years to the most meritorious article which has appeared in the *Klinische Monatsblätter für Augenheilkunde.* The selection will be made by five members: the chief editor, the president of the German Ophthalmological Society and three members, who will be selected by the editor and publisher.

The winner of the prize is to be announced at the meeting of the German Ophthalmological Society.

Trachoma Research.—The Indian Medical Service has set up a research program in trachoma under the supervision of Dr. Polk Richards and Dr. Fred Loe, of the Indian Medical Service, and Dr. Phillips Thygeson, of the Eye Institute, New York. The committee will carry on research treatment of trachoma with sulfanilamide and sulfanilamide derivatives. A comparative study of therapy with sulfanilamide and antimony and potassium tartrate will be made by Dr. Julianelle, of St. Louis, in cooperation with the physicians in the Indian Medical Service.

SOCIETY NEWS

American Academy of Ophthalmology and Otolaryngology.—Dr. Albert C. Snell, Rochester, N. Y., of the University of Rochester School of Medicine, was named president-elect of the American Academy of Ophthalmology and Otolaryngology at its forty-third annual session in Washington, D. C., October 9 to 14.

Dr. George M. Coates, Philadelphia, took office as president, having been elected at last year's meeting in Chicago.

Three vice presidents were elected: Drs. William W. Pearson, Des Moines, Iowa; William J. Mellinger, Santa Barbara, Calif., and Charles A. Bahn, New Orleans. Dr. William P. Wherry, Omaha, was reelected executive secretary-treasurer, and Dr. Secord H. Large, Cleveland, comptroller. Dr. Carl H. McCaskey, Indianapolis, was elected a member of the council, and Dr. Grady E. Clay, Atlanta, Ga., was chosen to represent the academy on the American Board of Ophthalmology.

The 1939 meeting will be held in Chicago.

Canadian Ophthalmological Society.—The Canadian Ophthalmological Society held its first annual meeting in Montreal, Aug. 24 to 25, 1938. Sir Stewart Duke-Elder, lecturer in ophthalmology, of St. George's Hospital Medical School, University of London, was the guest of honor, speaking on "Progress in Ophthalmology." A symposium on visual standards was presented, and a committee was appointed to formulate standards which will be available as an authoritative expression of the society. The second day was spent in clinical sessions at the Royal Victoria Hospital. The following officers were elected: Drs. W. Gordon M. Byers, Montreal, president; William H. Lowry, Toronto, vice president, and Alexander E. MacDonald, Toronto, secretary.

International College of Surgeons.—The International College of Surgeons will hold its assembly in New York at the Hotel Roosevelt on May 22-24, 1939. Dr. Edward Frankel Jr., 217 East Seventeenth Street, New York, has been appointed by the officers of the college as general chairman of this assembly. Any one interested in space for scientific exhibits may communicate with him.

Information, Statistics, Photographs Wanted for Book Concerning Industrial Eye Hazards.—The National Society for the Prevention of Blindness has issued a public call for (1) information concerning new industrial or occupational hazards to eyes, including both accident and disease hazards; (2) recent and significant statistics concerning any occupational hazards to sight, showing frequency, severity, causes, nature of injury, degree of impairment and cost; (3) photographs showing either hazards to sight or protection against such hazards, and, most important of all, (4) information concerning successful methods of eliminating, counteracting or alleviating the disease and accident hazards to eyes. The society's headquarters are at 50 West Fiftieth Street, New York.

This information is desired for consideration in the revision of Eye Hazards in Industrial Occupations by Lewis H. Carris, managing director of the society, and Louis Resnick.

De Schweinitz Lecture.—A lecture in honor of Dr. George E. de Schweinitz has been founded by the Section on Ophthalmology of the College of Physicians of Philadelphia, to be known as the de Schweinitz Lecture. The lecture is to be given annually on the third Thursday of November, on a subject to be chosen by the speaker selected.

S. Lewis Ziegler Prize.—Through the generosity of Mrs. Kathryn Ziegler Halsey and S. Lewis Ziegler Jr., the S. Lewis Ziegler Prize has been established by the Section on Ophthalmology of the College of Physicians of Philadelphia. One hundred dollars is annually offered for an original contribution to ophthalmology deemed of sufficient merit, the committee of award to be appointed by the chairman of the section. Theses for the 1938-1939 award must be in the hands of the committee by Oct. 1, 1939.

Iowa Academy of Ophthalmology and Oto-Laryngology.—Dr. J. K. Von Lackum, of Cedar Rapids, was elected president of the Iowa Academy of Ophthalmology and Oto-Laryngology for the 1939-1940 term at the annual convention of the organization in Davenport, Nov. 14, 1938. Dr. Dean M. Lierle, of Iowa City, succeeded Dr. Harry H. Lamb of Davenport as president for the coming year. Dr. Byron M. Merkel, of Des Moines, was reelected secretary-treasurer.

It was decided that the 1940 meeting will be held in Cedar Rapids. It had previously been decided that the academy will convene in Iowa City in 1939.

UNIVERSITY NEWS

Wayne University.—A total of $45,000 has been accepted by the Wayne University College of Medicine, Detroit, in support of research and teaching at the College of Medicine. The largest single gift was $10,000 for the establishment of a research laboratory in ophthalmology. Dr. Parker Heath, professor of ophthalmology, has charge of the laboratory. Gordon L. Walls, Sc.D., has been appointed research associate in ophthalmology.

PERSONAL

Dr. William B. Clark, of New Orleans, was recently made associate professor of ophthalmology at Tulane University School of Medicine, New Orleans, and placed in charge of the ophthalmic department of the Hutchinson Memorial Clinic and of graduate instruction in ophthalmology at the Eye, Ear, Nose and Throat Hospital.

PERSONAL

Dr. J. Warren Bell has been appointed medical director of the National Society for the Prevention of Blindness.

CORRECTION

In the article by Dr. Edmund B. Spaeth entitled "Etiology of Retinal Separation Considered from the Standpoint of Surgical Correction," in the December issue (ARCH. OPHTH. **20**:1046, 1938), the date "1893" in the twelfth line on page 1047 should read "1853."

Correspondence

PROLAPSE OF THE IRIS AT CATARACT OPERATION

To the Editor:—I have read Dr. Frank C. Parker's paper on a cataract operation to reduce the incidence of prolapse of the iris and his instruction on the movements of the iris during the incision with great interest (ARCH. OPHTH. **20:** 597 [Oct.] 1938). Like him, I have had an occasional prolapse after simple extraction of a cataract, but I adopted the small peripheral iridectomy to allow the fluid behind the iris to escape through the wound without prolapse of the iris. Since adopting this simple procedure many years ago, I have scarcely ever had a prolapse.

The only difficulty was that when iridectomy was done first the lens attempted to come through the coloboma instead of through the pupil. For some time I have done the peripheral iridectomy after the extraction, and this has been entirely satisfactory.

One drop of physostigmine salicylate after the operation insures firm contraction of the sphincter pupillae and can be followed by the use of atropine at the first dressing the next morning.

W. B. INGLIS POLLOCK, M.D., GLASGOW, SCOTLAND.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

TOPOGRAPHY OF MEDULLARY IRIDODILATOR FIBERS. J. DECHAUME and G. MORIN, Compt. rend. Soc. de biol. 127: 1486, 1938.

The experiments of the authors demonstrate that in the dog no iridodilator fibers leave the cord via the fifth, sixth or seventh cervical roots. In animals aseptically deprived of their spinal medulla below this region, and with the adrenal glands cut off from neural influence, the Horner syndrome resulted and the pupil failed to respond by dilatation to emotional stimuli. The effect was limited to the side destroyed, indicating that in the dog the sympathetic innervation to the eye is entirely homolateral.

J. E. LEBENSOHN.

Congenital Anomalies

CONGENITAL TORSIONAL NYSTAGMUS. J. OHM, Arch. f. Ophth. 138: 693 (May) 1938.

Seventy cases of congenital torsional nystagmus are thoroughly analyzed. Ohm's method of lever nystagmography is not suitable for the recording of pure torsion. The average visual acuity in cases of congenital torsional nystagmus is definitely better than in cases of albinism or of colobomas of the uvea. Characteristic of congenital torsional nystagmus is relatively good vision (better than 0.5; average, 0.68) in one eye combined with relatively poor vision (average, 0.25) in the other eye. Other motor anomalies are common in cases of this condition. Strabismus occurs in 61.4 per cent; in approximately half of these cases a constant horizontal deviation is combined with a vertical component the direction and degree of which varies in the different parts of the field of fixation (oblique strabismus). The mechanism of this form of strabismus is made the subject of lengthy speculative interpretations which do not lend themselves to abstracting.

P. C. KRONFELD.

Experimental Pathology

OBSTRUCTION OF THE IRIDOCORNEAL ANGLE BY NEGATIVE PRESSURE. F. KUKAN, Klin. Monatsbl. f. Augenh. 100: 68 (Dec.) 1938.

Kukan conducted a series of experiments on 15 patients to find out the cause of the decrease of intraocular tension after compression of the eyeball by massage or by the application of a tonometer or an ophthalmodynamometer. This phenomenon occurs, in his opinion, as the result of elimination of the aqueous humor through the iridocorneal

angle. He describes his method of examination by means of an ophthalmodynamometer and a small vacuum cup, which, placed over the cornea, rests on the limbus. A negative pressure of 150 mm. was produced by so-called pericorneal suction lasting three minutes, after which the tension was taken by the tonometer. He found that pericorneal suction failed to lower the tension and that it raised it in 1 case. So-called scleral suction, on the other hand, done with a larger cup produced a decided decrease in the tension of the other eye in this case. In those cases in which only a slight change in intraocular tension, or none at all, was obtained by pericorneal suction, no change was observed immediately after scleral suction. Expression of the blood during suction is irrelevant in lowering the tension, because the blood will return into the blood vessels as soon as the cup is removed.

The stretching of the sclera and the reduction of its elasticity occurs more distinctly during pericorneal, than during scleral, suction. Hence, the reduction of the tension resulting from stretching of the sclera is greater with pericorneal suction. This observation suggests that the difference in lowering the tension by these two methods is not increased but actually decreased by stretching and loss of elasticity of the sclera. Kukan concludes that in increased intraocular tension produced by compression the iridocorneal angle is the main passage for elimination of the aqueous humor.

K. L. Stoll.

General Diseases

Leprosy in Ophthalmology. Viallefont and Fuentes, Ann. d'ocul. **175:** 380 (May) 1938.

The role of leprosy as a factor in blindness is important. Though the disease is rare in France, it is fairly common in certain quarters of the world. Of 31 patients examined, 22 presented more or less important lesions and 9 were blind. Nearly all the patients had definite iritis, with exudation and numerous synechiae. In 1 the iritis took on a peculiar aspect, such as that to which Cange has drawn attention. In a large number of the patients different forms of keratitis were present, either as a diffuse leukoma or as isolated, round, grayish lesions. The authors did not note any appreciable lesions of the fundus in those cases in which they were able to examine the interior of the eyes. They did not observe atrophy of the optic nerve or chorioretinitis, but the examination was rendered impossible in many instances by the lesions of the anterior segment.

From a clinical point of view, the lesions that the authors observed were similar to those of tuberculosis. The differential clinical diagnosis between tuberculosis and ocular leprosy is difficult, but when leprosy is evident, laboratory examination simplifies the matter.

S. H. McKee.

Constitution and Ocular Tuberculosis. W. Steinberg, Klin. Monatsbl. f. Augenh. **99:** 784 (Dec.) 1937.

Steinberg examined 100 men and 100 women in whom the tuberculous genesis of their ocular disease was either firmly or, at least,

convincingly established. Children and young adults were excluded, because their type of constitution cannot be determined definitely. The physical constitution of these patients was determined by Kretschmar's method, which includes the collection of anamnestic, somatometric and descriptive data. The various types of constitution are described and recorded in tables. Steinberg could not corroborate the findings of Brückner and of Gigon, which were based on examination of natives of Switzerland. Steinberg's patients with ocular tuberculosis were not of a predominantly pyknic type, but they were fairly evenly distributed in the three types, the pyknic, the athletic and the leptosomatic. The difference of Brückner's findings may be due to a greater admixture of the Eastern and Alpine races than in Steinberg's territory, the Black Forest, and among his other patients who came from cities and country districts in Germany. Numerous dysplasias, especially those of a hypogenital type, and frequent thyroid anomalies found in his patients, prompt Steinberg to suspect a partial constitutional anomaly favoring atypical localization of ocular tuberculosis. This supposition receives support by the almost general benignity of the pulmonary tuberculosis in the patients with ocular tuberculosis. Their robust build and good nutritional condition would suggest a lymphatic condition resembling a hypoplastic status, in which the lymphatic condition has to be considered as a partial manifestation. Frequent attacks of catarrh of the upper part of the respiratory tract and nasal adnexa, scrofulosis, abscesses of the glands and rheumatism of the joints in these patients may be explained in this connection. Atypical localization of the tuberculosis of these patients in the eye is probably due to inferiority of the ocular tissues, as a result of general constitutional anomaly, brought on by their lymphatic or hypoplastic status. Decreased resistance of the eye, on the other hand, may be caused by previous traumatic lesions or nontraumatic diseases.

K. L. Stoll.

Glaucoma

New Developments in the Pharmacological Treatment of Primary Glaucoma. M. J. Schoenberg, Brit. J. Ophth. 22: 417 (July) 1938.

Schoenberg reviews the essentials of the theory of chemical mediation of nerve impulses, the mode of action of sympathicomimetics (Sy-Mi) and parasympathicomimetics (Pa-Sy-Mi) and the rationale of the pharmacologic local treatment of glaucoma.

The author gives the following summary:

"1. Nerve impulses travelling along the two branches of the vegetative nervous system are transmitted to the secretory or contractile cells by the aid of a chemical mediator (acetylcholine or sympathin, respectively).

"2. There are evidences which support the assumption that in primary glaucoma, there is a disturbance (functional or organic) of one or both branches of the vegetative nervous system, within the eye.

"3. The present pharmacological treatment of primary glaucoma endeavors to correct such a disturbance by dealing with each or with all three of the components of the neuro-effector unit.

"4. As far as we know, drugs that have a beneficial effect upon eyes with a primary glaucoma, possess the property of acting either on the esterase (which neutralises acetylcholine) or on the effector cells.

"5. There is need of more knowledge on the subject of dysfunction or degeneration of the parasympathetic and sympathetic nerve terminals, more information on details regarding the process of release of acetylcholine and esterase, also on affectations of effector cells. There is also need of drugs or other means which can re-establish the normal function of any one of the three components of the neuro-effector unit, whenever impaired.

"6. Clinical experience leads us to believe that in some cases of primary glaucoma, we are dealing with a failing function of the ocular parasympathetic, in others with a preponderance of the ocular sympathetic, and in still other cases with a combination of both conditions. Thus, we may classify—for the present—the various types of primary glaucoma in three groups: sympathetic, parasympathetic and mixed.

"7. The adoption of this classification may prove to be helpful to the progress of our knowledge of the pharmacological treatment of primary glaucoma."

W. ZENTMAYER.

Injuries

WHY OPERATE EARLY IN CASES OF SEVERE BURNS OF THE EYE? O. THIES, Arch. f. Ophth. **138:** 686 (May) 1938.

For more than thirty years Denig has been advocating his method of covering severely burned areas of bulbar conjunctiva with free transplants of mucous membrane shortly after the injury. Thies, the author of a recent monograph on "Burns of the Eye" (Stuttgart, Ferdinand Enke), now summarizes the experimental and clinical evidence which made him adopt Denig's method. The operation should be performed within the first seven hours after the injury, but "not much is lost if one performs the operation within the first twenty-four hours." The evidence presented in the paper appears to show that the results of early operation are definitely better than those of conservative treatment. The mechanism of this beneficial influence of the surgical treatment is not clear.

P. C. KRONFELD.

Instruments

MEASUREMENT OF THE ANGLE OF MAXIMUM CONVERGENCE. H. G. MARTIN, Am. J. Ophth. **21:** 161 (Feb.) 1938.

Martin describes a method for measuring maximum convergence which he considers a more representative and equitable means of determining this function than other methods. The results lend themselves more readily to comparison with the accommodative function. The instrument used is described.

W. S. REESE.

A NEW OPHTHALMODYNAMOMETER. J. KEIL, Klin. Monatsbl. f. Augenh. **99**: 625 (Nov.) 1937.

The use and scope of the ophthalmodynamometers are described, and the advantages of Keil's own device are reported in detail. This instrument is a compression dynamometer, containing no springs. The values obtained with it are reliable and accurate; they may be read easily on scales on both sides of the apparatus. Owing to its symmetric construction, this apparatus may be used for both eyes; it is small and easy to handle.

K. L. STOLL.

Lens

VITAMIN C BALANCE IN PATIENTS WITH SENILE CATARACT. J. SEEFRIED, Arch. f. Ophth. **138**: 620 (May) 1938.

The relation between vitamin C intake and excretion in patients with senile cataract was determined by means of the tolerance test of Jezler, Kapp and Niederberger. The patient receives daily, in addition to his ordinary diet, 300 mg. of vitamin C by mouth. This abnormally high intake raises the vitamin excretion in the urine. The number of days which must elapse until the patient's system becomes so saturated with vitamin that 50 per cent of the daily intake is excreted again in one day has been found to be a significant index of the patient's vitamin C metabolism. Comparing 44 patients with senile cataracts with 25 controls of approximately the same age, the author found that, on the average, it takes the patient with senile cataract three days longer than the control to reach the point where 50 per cent of the vitamin intake is excreted again. This suggests the presence of a general disturbance of the vitamin C metabolism in cataractous patients.

P. C. KRONFELD.

EXPERIMENTAL STUDIES ON ROENTGEN CATARACT. H. GOLDMANN and A. LIECHTI, Arch. f. Ophth. **138**: 722 (May) 1938.

The authors solved the problem of "focusing" roentgen rays on certain portions of the lens by using a very narrow, but concentrated beam and by determining its position with regard to the eye by dusting a fluorescent powder on the cornea. The distance between the focus of the tube and the cornea was 29 cm., and the voltage was 200 kilovolts. The radiation was filtered through 1 mm. of aluminum. The doses applied to the surface of the cornea varied from 1,500 to 2,000 roentgens. At a distance of 15 mm. from the irradiated surface, about 90 per cent of the surface doses were still present. With this technic the authors irradiated in rabbits (*a*) peripheral portions of iris and lens, (*b*) only axial portions of lens and (*c*) only peripheral portions of lens (several months after iridectomy). In the animals of the first group opacities of the lens developed about in from three to four months after irradiation. The first opacities became visible in axial portions of the lens, near the sutures, that is, in portions which had not been irradiated. No opacities of any kind developed in the animals in the second group. The axial portions of the lens thus proved to be insensitive

to direct irradiation. In the animals belonging to the third group axial opacities of the lens were noticed, similar to those found in the first group. The authors conclude that the "point of attack" (*Angriffspunkt*) of the roentgen rays is the equator of the lens. The iris and the ciliary body play no demonstrable part in the development of roentgen cataract. The first visible changes occur at the extremities of the lens fibers. In the region of the opacities one can observe the formation of a new suture, which again indicates damage to the germinative lens epithelium that manifests itself as formation of shorter fibers.

P. C. KRONFELD.

Methods of Examination

ENTOPTIC DEMONSTRATION OF THE YELLOW COLOR OF THE MACULA CENTRALIS RETINAE. R. ZUBLER, Arch. f. Ophth. **138:** 633 (May) 1938.

In 1925 A. Vogt reported that the yellow color of the macula can be made visible entoptically by diascleral incidence of red-free light rays emitted by an arc lamp which is run on direct current. The author of the paper under review, under Vogt's guidance, has made a thorough study of the conditions governing this entoptic phenomenon and of its parallactic modifications. No new facts are reported, but previous observations are confirmed and thoroughly analyzed.

P. C. KRONFELD.

Neurology

HYPERTROPHIC INTERSTITIAL NEURITIS WITH PAPILLEDEMA. A. W. DIDDLE and R. L. STEPHENS, Arch. Neurol. & Psychiat. **40:** 1 (July) 1938.

A case of hypertrophic interstitial neuritis, a condition first described by Dejerine and Sottas in 1893, is presented. The patient, a 26 year old man, gave a history of pain, numbness and weakness of arms and legs with increased difficulty in walking for two years and intermittent blurring of vision for three years.

The principal clinical findings of significance were: hypesthesia of the glove and stocking type; partial paralysis and muscular atrophy of the extremities; hypertrophy of the peripheral nerves and moderate loss of vision. Associated with this were bilateral papilledema and increase in the cerebrospinal fluid pressure and the total protein content of the spinal fluid. The reflexes were diminished or absent. Fibrillary tremors were observed at an earlier stage in the disease. During the period of observation difficulty in swallowing, with secondary paralysis of the left vocal cord, developed. As a therapeutic measure, 1,500 roentgen units was given over the right brachial plexus, with the left side as a control. Clinically, there was no improvement.

The diagnosis was confirmed by histologic examination of an affected nerve removed for biopsy. References are given to previously reported cases.

R. IRVINE.

SUBOCCIPITAL PUNCTURE IN CRANIAL TRAUMA FROM AN OPHTHALMIC POINT OF VIEW. AROLDO PAVIA, Arch. de oftal. de Buenos Aires 13: 92 (Feb.) 1938.

Four patients were seen at different intervals after cranial trauma with symptoms of cranial hypertension consisting of intense headache, vertigo, asthenia and disturbances of accommodation. There were no visual disturbances or changes in the fundus. No benefit was obtained from lumbar puncture, but marked relief followed suboccipital puncture, which presents no difficulty or danger. Pavia does not consider that there was any blocking of the medullary canal in these cases. He refers to a report of Magitot in 1936 of 7 similar cases.

C. E. FINLAY.

Ocular Muscles

MINER'S NYSTAGMUS IN THE SAAR REGION. O. WIEDERSHEIM, Arch. f. Ophth. 138: 515 (May) 1938.

The author, who is director of the ophthalmic clinic for miners in Saarbrücken, has been especially interested in miner's nystagmus for the last ten years. He now gives a comprehensive review of the subject, covering the clinical and scientific, and also the social and economic, aspects of this disease, which affects from 5 to 10 per cent of the coal miners in the Saar. One of the author's original contributions to the study of miner's nystagmus is a photographic method to record the nystagmic oscillations. From the apex of a blackened contact lens a thin metal rod, on the end of which is a shiny button, protrudes in a radial direction. The contact lens is inserted over the cornea of the patient affected with nystagmus, and the excursions of the shiny button are photographed. The most common form of nystagmic excursions in miner's nystagmus is a horizontal or oblique ellipse. The more common frequencies are from 240 to 320 oscillations per minute. The mildest degree of the nystagmus occurs only in the mine (in the dark) if the miner is moving about; the severest degrees are present in daylight even if he is resting in bed. Of great importance is the portion of the field of fixation in which the miner's nystagmus occurs (*Zitterfeld*, field of nystagmus). The onset of the condition is slow and insidious. It usually takes from eleven to fifteen years of work in the mines before the miners become aware of visual difficulties caused by the nystagmus. With regard to the cause of miner's nystagmus, the author agrees with Bartels, Ohm, Randnitz and others in that it is chiefly the insufficient illumination which leads to a disturbance of the delicate neural apparatus that controls the fixation mechanism. Besides, the author believes that the susceptibility to a disturbance of the fixation mechanism varies among different persons and that at the first ocular examination of the prospective miner special attention should be paid to preexisting weakness of the fixation apparatus. The problem of miner's nystagmus is chiefly one of lighting, which can be expected to be solved within the next two decades. Until then, miners with cases of a severe nature should not be pensioned, but their condition should be detected early and they should be given work outside the mine (in present Germany, chiefly roadbuilding and highway construction).

P. C. KRONFELD.

Operations

THE USE OF MUCOUS MEMBRANE IN OPHTHALMIC SURGERY. E. B. SPAETH, Am. J. Ophth. **20:** 897 (Sept.) 1938.

This well illustrated article does not lend itself to abstracting as it deals mostly with technics. Spaeth draws the following conclusions:

"In general, while mucous-membrane grafts have a limited application, these indications are very definite, and, if they are considered carefully, the results obtained should be satisfactory.

"The technique for operating is not difficult; every operating ophthalmologist is capable of the surgery; and most important of all there is no other method available (nor is another necessary) for correcting the defects and the deformities for which the surgery is applicable."

W. S. REESE.

PLASTIC REPAIR OF LID HERNIA WITH FASCIA LATA. B. R. SAKLER, Am. J. Ophth. **20:** 936 (Sept.) 1938.

Sakler describes an operation for the plastic repair of boggy lower lids due to a hernia of intraorbital fat. A fascia lata transplant forms a new orbital septum, anatomically placed and physiologically correct, giving good cosmetic result.

W. S. REESE.

Orbit, Eyeball and Accessory Sinuses

DACRYOETHMOIDITIS: HISTOLOGIC INVESTIGATION AND PATHOGENIC CONSIDERATION. A. POSARELLI, Riv. oto-neuro-oftal. **13:** 555 (Nov.-Dec.) 1936.

Posarelli presents a histopathologic study of the pathways of extension of nasal and paranasal inflammatory conditions to the region of the lacrimal sac. After reviewing anatomic studies of both regions, he describes a number of clinical observations and shows, with the help of photomicrographs, that the extension of the process may take place through venous pathways as well as by continuity and contiguity.

Posarelli goes on to show, as a number of others have shown, that dacryocystitis and peridacryocystitis may have their origin in inflammatory conditions of the paranasal sinuses.

In closing, he proposes on the basis of his studies the name dacryosinusitis in place of the simpler term dacryoethmoiditis.

F. P. GUIDA.

INCOMPLETE SYNDROME OF THE ORBITAL APEX ON A TRAUMATIC BASIS. L. VENCO, Riv. oto-neuro-oftal. **14:** 20 (Jan.-Feb.) 1937.

Venco describes a case of trauma to the left side of the head in which ptosis of the left upper lid, divergence of the left eye and a rapid loss of vision followed almost immediately. Examination showed paralysis of the third nerve but active fourth, fifth, sixth and seventh nerves and the presence of a secondary descending atrophy of the optic nerve. Other neurologic signs were absent.

Roentgenographic examination revealed fracture of the lesser wing of the sphenoid bone at its base, probably by contrecoup, so that it encroached on the optic canal and part of the superior orbital fissure. The mechanism involved was probably one of contusion, compression and laceration of the third nerve and the optic nerve.

F. P. GUIDA.

INFAMMATORY PSEUDOTUMORS OF THE ORBIT WITH UNILATERAL EXOPHTHALMOS: REPORT OF TWO CASES. H. SAUTTER, Klin. Monatsbl. f. Augenh. **100**: 29 (Jan.) 1938.

After referring to the division of orbital pseudotumors into 3 types by Birch-Hirschfeld, Sautter reports 2 cases of the second type. Operation on patients with this type of tumor shows an absence of a tumor, but the presence of diffused cell infiltration of the orbital tissues and profuse endarteritis. Sautter reports 2 cases, that of a man aged 54 and that of a woman aged 22. Both presented chronic phlegmonous infiltration of the orbital tissues. No genetic cause for the condition could be found; cloudiness of the collateral frontal and ethmoid sinuses in the man was considered too slight to be the etiologic factor, and no pathologic changes were found in the woman. The condition coincided, as to etiology, with that in the other cases cited. Sautter favors the terminology of "inflammatory pseudotumors of the orbit," however, in as limited a manner as possible and not unless histologic and animal research have been done. The author mentions that the condition in his cases differs from that in the 4 cases recently reported by Franceschetti and Rutishauser.

K. L. STOLL.

Physiology

EXPERIMENTAL DATA ON THE PROBLEM OF THE PERMEABILITY OF THE CORNEA. I. M. KLEIN, Brit. J. Ophth. **22**: 401 (July) 1938. II. M. KLEIN and J. J. SARKANY, ibid. **22**: 409 (July) 1938.

The first part of this article deals with experiments on excised pigs' eyes and living rabbits' eyes with iodide and nitrite.

The second part has to do with the permeability of the excised cornea with respect to water and chloride ions.

The authors give the following summary:

"1. Under the influence of colloidal osmotic forces a flow of water through the cornea is possible.

"2. This permeability exists not only in the epithelial-endo-thelial direction, but also in the reverse direction.

"3. Chloride ions under the influence of osmotic pressure can diffuse to the opposite surface in both directions."

W. ZENTMAYER.

INTRAOCULAR TENSION AND RETINAL BLOOD PRESSURE AFTER INTRAVENOUS INJECTIONS OF EPINEPHRINE HYDROCHLORIDE. G. SALA, Ann. di ottal. e clin. ocul. **66**: 9 (Jan.) 1938.

The literature on the effects of epinephrine is reviewed. Nearly all previous observations were concerned with the use of the drug by instil-

lations or by subconjunctival injections. The results were in many respects discordant. The author records observations on 14 patients after intravenous injections of from 0.01 to 0.1 mg. of epinephrine hydrochloride. Results were uniform in the series. No effects on ocular tensions were observed with less than 0.03 mg. With 0.03 mg. a slight rise of tension was observed during the epinephrine crisis, usually 3 mm. (Schiötz), while the increase in blood pressure was marked (from 136 to 186 systolic, for example). With 0.1 mg. of epinephrine hydrochloride, the increase in tension amounted to 7 or 8 mm., while the systolic blood pressure returned rapidly to the previous figures. In 12 cases the retinal arterial pressure was also recorded. This showed a marked rise during the epinephrine crisis, from a normal of 75 systolic and 35 diastolic, for example, to 105 systolic and 60 diastolic after the injection of 0.03 mg. After the injection of 0.1 mg. the pressure rose to 140 systolic and 68 diastolic, dropping rapidly to normal. No visible change in caliber of the arteries was seen, but the veins appeared more engorged, and the appearance of a venous pulse, not previously present, was frequently observed.

S. R. GIFFORD.

Retina and Optic Nerve

NEUROMYELITIS OPTICA. S. H. McKEE and F. L. McNAUGHTON, Am. J. Ophth. **21:** 130 (Feb.) 1938.

McKee and McNaughton present the following summary:

"Two cases of myelitis with striking loss of vision are reported. In both there has been ultimate recovery of vision but incomplete recovery from the myelitis.

"In case 1, an adult male, a Canadian, 34 years old, there was a definite history of infection. Visual disturbance, simultaneous in both eyes, and eye discomfort were the first symptoms complained of. These were followed later by transverse myelitis of moderate degree. There were no fundus changes, and recovery was practically complete. The spinal fluid exhibited some evidence of an inflammatory process.

"In case 2, an adult Italian male, 41 years of age, there was no history of infection. Visual disturbance occurred first in one eye and then in the other, with a considerable interval between the attacks. Eye discomfort similar to that present in case 1 was also complained of. The eye symptoms in this case followed the symptoms of myelitis, which were much more severe than in case 1, and resulted in incomplete recovery. Definite fundus changes occurred during the course of the disease. Examination of the spinal fluid showed no change.

"Both cases have been recently examined (April, 1937). The vision, fundi, and fields in each were quite normal. It is of neurologic interest that, in addition to the signs of optic-tract and spinal-cord disease, both cases showed slight signs indicating invasion of the brain stem. In case 1 there was limitation of upward gaze early in the illness; later, lateral nystagmus developed. In case 2, a diminished left corneal reflex was manifested. Such signs have been reported in some cases of neuromyelitis optica."

W. S. REESE.

THE LAURENCE-BIEDL SYNDROME OCCURRING IN A BROTHER AND SISTER. T. K. RATHMELL and M. A. BURNS, Arch. Neurol. & Psychiat. 39: 5 (May) 1938.

The authors feel that although the Laurence-Biedl syndrome is generally known, the disputed etiology makes a report of true syndromes of this type or variants worth while. Several hypotheses as to etiology are mentioned.

The brother and sister described had Russian Jewish parents who were first cousins. The syndrome is based on the factors of familial history, mental deficiency, obesity, retinitis pigmentosa, hypoplasia or inadequacy of the genitalia with distribution of hair characteristics of the opposite sex, phalangeal synostosis, phalanges of the Telford-Smith type and budding of the phalanges.

In Dr. H. E. Riggs' discussion of this paper, she reported the examination of the brain in 2 cases of this syndrome. She states that she has seen evidence in the cerebral cortex and brain stem of widespread arrest in development in early intrauterine life, and her studies suggest that malformation of the visual cortex may play as large a role in the defective vision as does the retinitis pigmentosa.

Burns concludes the discussion, emphasizing the possibility that these patients, 1 of whom reached the eighth grade in school, and the other, the fourth, might have failed to progress farther because of lack of vision. He suggests that if patients of this type could be educated much as are the blind by means of the Braille system, many now considered mentally defective might be educated to take care of themselves.

R. IRVINE.

A CASE OF ANGIOMA RETINAE. I. FEIG, Brit. J. Ophth. 22: 295 (May) 1938.

The unusual appearance of the fundus of the right eye of a woman aged 45 is described. In the region surrounding the papilla there was an outspread network of blood vessels, in which upper and lower layers could be distinguished, partially entangled with each other. In the upper layer, thick blood vessels issued outward in all directions (the thickest of these, which was almost of the thickness of the papilla, pointed downward) and diminished spindlewise in thickness after branching out, so that the network became thinner as it approached the circumference. Below this an entanglement of blood vessels was visible, entwined among those in the upper layer and appearing as rings in certain places. Within a range of approximately six or seven times the width of the papilla nothing but blood vessels could be seen. These were accompanied throughout their length by white reflexes. The periphery showed white areas of degeneration in the choroid. Toward the upper part of the circumference of the fundus there was a gray-green sheen, i. e., a partial surface detachment of the retina.

Feig believes the case to be one of apparently primary angioma which has not led to any other disturbances. Later hemorrhages into the vitreous occurred.

An illustration accompanies the article.

W. ZENTMAYER.

RETINAL HEMORRHAGES BROUGHT ON BY OVERSTRAIN DURING FLYING. J. SEDAN, Ann. d'ocul. **175**: 307 (April) 1938.

The question of physiologic and pathologic vascular reactions to altitude and its variations has become, on account of the rapid progress in aviation, the object of much study and research.

The author, having seen by chance 2 cases of retinal hemorrhages brought on by overstrain at a comparatively high altitude, sought for competent advice on the subject and found it in articles by Beyne, Binet, Bergeret and Flamme. Observations on these 2 cases are given in detail. There is an extensive bibliography.

S. H. MCKEE.

HEREDITARY ATROPHY OF THE MACULOPAPILLARY BUNDLE. R. E. GIQUEAUX, Arch. de oftal. de Buenos Aires **13**: 111 (March) 1938.

Hereditary atrophy of the maculopapillary bundle in 8 members of a single family in 3 generations is reported. In all the members examined the defect was noticed at an early age and was coincident with slight myopia. The ophthalmoscopic picture was that of atrophy of the optic nerve limited to the temporal quadrant. The limits of the visual fields were normal, with a corresponding central scotoma. No general disease was found related to this condition. In some the disease was transmitted by the paternal, and in others by the maternal, line. The disease seems similar to Leber's hereditary atrophy in regard to involvement of both eyes and in its nonprogression after reaching its maximum; it differs in a more precise central localization, in localization of the atrophy to the temporal quadrant and in its earlier appearance.

C. E. FINLAY.

PRESENT STATUS OF THE OPERATIVE TREATMENT OF RETINAL DETACHMENT. C. E. FINLAY, Rev. cubana de oto-neuro-oftal. **6**: 24 (Jan.-Feb.) 1937.

The present status of the operative treatment of retinal detachment is reviewed. The author points out that a modification of Gonin's original operation devised by him several years ago is practically the same as the modern operation of diathermy. In this operation subretinal puncture was subsequently performed and the order of the steps was reversed; also galvanocautery was employed in place of diathermy. In this paper the author stresses Pavía's method of localization of the tear by external illumination with a small lamp fixed at the end of a long probe and the observation of its effect ophthalmoscopically.

C. E. FINLAY.

ENDOANGIITIS OBLITERANS: REPORT OF A CASE. H. GESERICK, Arch. f. Ophth. **138:** 647 (May) 1938.

In a German blacksmith who had taken part in the World War there developed in 1921, when he was 28, visual disturbances which were found to be caused by recurrent retinal hemorrhages. In 1925 he was admitted to the ophthalmic clinic of the University of Jena, and the diagnosis of choroiditis of tuberculous origin and of retinitis proliferans of both eyes was made. Under treatment with tuberculin the fundi showed signs of temporary improvement, but later the vascular disease became progressive again and atrophy of the optic nerve set in. In 1934 the fundi presented the picture of extensive obliterating endoangiitis with mild choroiditic changes. In addition, a serious nervous disease developed which was characterized by multiple lesions resembling those seen in multiple sclerosis. The pulsation in the dorsalis pedis arteries could not be felt. The author interprets this case as one of thromboangiitis obliterans. This condition was first considered as cause of retinal periphlebitis by Marchesani (*Arch. f. Augenh.* **109:** 124, 1935). On the other hand, Oppenheim in his "Lehrbuch der Nervenkrankheiten" (Berlin, S. Karger, 1913) first mentioned cases of multiple sclerosis caused by "a general vascular disease." The conclusion is justifiable that the fundus picture of retinal periphlebitis or of retinitis proliferans does not always indicate a tuberculous disease of the wall of the vessel. The cause of Buerger's disease is still unknown.

P. C. KRONFELD.

Trachoma

FREQUENCY OF PARENCHYMATOUS VESSELS IN THE CORNEA OF PATIENTS WITH TRACHOMA. A. BUSACCA, Arq. brasil. de oftal. **1:** 5 (June) 1938.

After reference to the literature on the situation of the newly formed blood vessels in trachomatous pannus with respect to Bowman's membrane, the author reports the result of the biomicroscopic examination of 100 eyes of 50 patients with trachoma. He finds blood vessels in the corneal stroma in 44 per cent of the patients and in 34 per cent of the eyes examined.

He classifies these vessels according to their origin into vessels proceeding from the limbus and into vessels originating in the pannus and according to their manner of distribution into simple or scarcely ramified and reticular vessels.

He discusses the differential diagnosis of syphilitic keratitis. Busacca finds these parenchymatous blood vessels even when the pannus is not much developed. In the cases in which they are found, the trachoma is more severe and less amenable to treatment.

C. E. FINLAY.

THE LATEST RESULT OF ETIOLOGIC RESEARCH OF TRACHOMA. L. POLEFF, Klin. Monatsbl. f. Augenh. **99:** 584 (Nov.) 1937.

Poleff presents a detailed résumé of recent research on trachoma, done by Szily, Busacca, Cuénod and others. The rickettsias, resembling the inclusion bodies of Prowazek and Halberstädter, have been described

almost identically by Busacca and Cuénod. Cuénod and Nataf found a "genuine culture of rickettsias" in the digestive tract of lice which they inoculated. These authors proved definitely the identity of the germ of trachoma and of Rickettsia rocha-limae, a parasite of the vestment house. A watery solution containing dirt from the nails of a small girl, infested with lice, was instilled into the eyes of a Maccacus rhesus; trachoma developed, and rickettsias were found in the lacrimal fluid. Poleff succeeded in growing tissue of trachoma in vitro. He obtained tissue cultures of conjunctival trachoma follicles and corneal pannus. These infrabacterial bodies, resembling those described by Cuénod and Nataf, could be cultured by Poleff under certain conditions. He could prove, furthermore, that cultures of rickettsias affected the eyes of rabbits pathologically; they produced intraocular formation of follicles, followed by atrophy of the eyeball, when they were introduced into the vitreous and descemetitis when they were introduced into the anterior chamber. Poleff gained the conviction from his experiments with pure cultures of rickettsias that they are identical with the formations described by Cuénod and Nataf and that they are the cause of trachoma.

K. L. Stoll.

Tumors

Cylindroma of the Orbit. Carlos S. Damel and E. R. Villegas, Arch. de oftal. de Buenos Aires **13**: 62 (Feb.) 1938.

A case of orbital cylindroma arising from the lacrimal gland is reported. Krönlein's operation was performed, and histologic examination showed the growth to be a cylindroma of the lacrimal gland.

C. E. Finlay.

Protrusion of the Eyeball in Carcinoma of the Parotid Gland with Metastases at the Base of the Skull: Report of a Case. H. Heymann, Klin. Monatsbl. f. Augenh. **100**: 23 (Jan.) 1938.

Heymann reviews the various types of orbital carcinoma and the literature in point. His own case was that of a woman aged 39, who had keratitis due to lagophthalmos of the right eye in February 1937. The left eye was free from congestion, and vision was normal. The patient had suffered from chronic otitis media since 1931, which resulted in paresis of the facial nerve in 1933. The right eye protruded; the measurements with Hertel's apparatus were 20 mm. in the right eye and 18 mm. in the left. The parotid gland, swollen since 1931, was treated with roentgen rays in 1934. The protrusion increased after the patient's admission to the hospital, but the disk remained normal. The result of detailed examinations suggested that the tumor grew from the parotid gland upward through the bone into the middle cranial fossa, then anteriorly and medially toward the right orbit. This tumor was a solid carcinoma containing basilar cells.

K. L. Stoll.

Uvea

UVEOPAROTITIS WITH PERIVASCULITIS AND OTHER RARE SYMPTOMS: REPORT OF A CASE. GUNNAR VON BAHR, Acta ophth. **16:** 101, 1938.

Swelling of the lacrimal and parotid glands, iridocyclitis, a few small, gelatinous iris nodules and fever developed in a 42 year old man. There were also present in the upper eyelids several small, compact tumors. On excision, these proved to be composed of typical tubercle-like granulation tissue at the site of tubules of the accessory lacrimal glands (Krause's glands). Inoculation of this tissue into a guinea pig gave no results. The most interesting and unusual feature of the case was the presence of a mild perivasculitis, as manifested by a narrow, grayish white sheathing around some of the retinal veins and in one place, around an artery. This perivasculitis disappeared entirely in a few weeks, as did the iris nodules.

O. P. PERKINS.

Vision

VISUAL ACUITY OF NOMADS IN ASIA MINOR. S. IRMAK, Deutsche med. Wchnschr. **64:** 677 (May 6) 1938.

A discussion of the various methods of determining visual acuity and the means of deciding what is the angle subtended introduces the article. The author concludes from his work with the nomads in Asia Minor that they have the keenest vision of all peoples. In one patient vision was nine times the normal. The visual angle for the minimum visible subtends 5.5 seconds; the retinal image, 0.34 millimicrons. Even in the aged a vision of twice or three times normal is frequently found. Good vision seems to be a dominant characteristic. A bibliography accompanies the article.

L. L. MAYER.

CENTRAL SCOTOMA IN CONGENITAL AND STRABISMIC AMBLYOPIA. E. HAITZ, Klin. Monatsbl. f. Augenh. **99:** 761 (Dec.) 1937.

Heine proved that unilateral amblyopia without pathologic changes was usually caused by a central scotoma, which he found in 90 per cent of the patients he examined. Uhthoff found a central scotoma in only 50 per cent of 100 patients, because he eliminated those whose vision was less than one sixth of the normal. Haitz has devised a binocular stereoscopic method with which he and a number of other ophthalmologists were able to show far smaller scotomas than they could demonstrate with other methods. The diameter of the scotomas varied between 2 and 6 degrees; their shape was usually round, and they were often connected with the blindspot. The paracentral scotomas were usually located temporally from, and close by, the center. The peripheral outline of these fields was usually normal for white and colors.

K. L. STOLL.

Miscellany

AN ACCOUNT OF THE OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM*

L. VERNON CARGILL, F.R.C.S., LONDON, ENGLAND

REVIEWED BY BURTON CHANCE, M.D., PHILADELPHIA

The *Medical Press and Circular* for some time past has published several series of articles sketching the history of British medical societies. In the January 1938 issue there is an account of the Ophthalmological Society of the United Kingdom, prepared by L. Vernon Cargill. So important has this society been in the modern development of ophthalmology that the ARCHIVES deems it fitting that younger readers should know somewhat in detail the chief events of its history. It is well that the causes of the needs for such an organization should be viewed in retrospect.

In the earliest years of the nineteenth century the practitioners in England who treated diseases of the eye treated general diseases as well, yet it was likely that they were especially skilful only in certain maneuvers for the relief of particular ocular conditions. In consequence, long before the middle of the century a number of surgeons had attained celebrity, although the knowledge they had acquired was based on what they had found by their study solely of the external features of the ocular globe and the orbit. Cataract and glaucoma could be understood at most only as viewed by the naked eye, with the help, perhaps, of the condensing lens, as instituted by Mackenzie, for not until 1851 was the ocular fundus visible during life.

The invention of the ophthalmoscope brought about a marvelous revelation, yet it was not for several years that many observers in England were competent to explain what to them had become visible. By the average user of the instrument, ophthalmoscopy seemed difficult of comprehension, yet because of the seeming complexity and because of what they expected from the shadows of what they feared might ultimately lead to blindness and destruction of the globe, men determined to master the intricacies of the investigation. In the succeeding twenty years, through the intensification of their studies which had been induced by the use of the ophthalmoscope, knowledge of the facts relating to ocular diseases became more widely disseminated and their seriousness appreciated. Many who had been practicing general surgery gradually became more engrossed in the comprehension of ophthalmic problems and steadily allowed other subjects to recede from the horizon of their daily practice.

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*Cargill, L. V.: Ophthalmological Society of the United Kingdom, M. Press **196**:4 (Jan. 5) 1938.

The fact of this specialization aroused in the minds of the foremost physicians in Great Britain a desire to form some sort of union for mutual recognition and fellowship and for the furtherance of scientific investigation and more exact practice.

The Royal London Ophthalmic Hospital, established by Saunders so early as 1804, and "dispensaries for curing diseases of the eye and ear" were in existence in various parts of the United Kingdom, yet for many years Moorfields and other special hospitals were regarded somewhat askance, in spite of the honorable work which had been accomplished by Farre, Saunders, Travers, Lawrence, Tyrell, Dalrymple, Guthrie, Mackenzie, Middlemore and others. The word ophthalmology had hardly become current, and so late as 1868 ophthalmic practice had no special service assigned it in the schools or by the general hospitals.

The activities at the Royal Ophthalmic Hospital, soon to be called and still affectionately remembered as Moorfields, had from the start attracted and held many who were determined to create a true division of medicine, so swift and brilliant was the progress that followed the introduction of the ophthalmoscope. The revolution which the use of that instrument instigated brought the range of ophthalmology within the scope of general medicine, and workers in England were keeping pace with the strides set by investigators on the Continent; the subject of ophthalmology henceforth became of vital interest in medical circles.

Moorfields at that time was located in the region of Finsbury, then a wealthy residential section, and many young medical men resided there. It became the custom for those who were interested in ophthalmology and who resided around Moorfields on certain evenings in the week to gather at the hospital, in the house surgeon's room, to discuss cases and other matters in which they were interested. A sort of Moorfields Club was formed; so far back as 1866 Jonathan Hutchinson records in the *Ophthalmic Hospital Reports* how he read a paper at such a meeting.

At one of those informal meetings early in 1880 it was suggested that an ophthalmologic society be formed. A circular was drawn up and sent to the leading ophthalmic surgeons in the three divisions of the United Kingdom, inviting them to help form a society. It met with a cordial response, and a preliminary meeting was held in June of that year, which was attended by 28 of the leading men among ophthalmologic practitioners. A society was then formally organized, and William Bowman was acclaimed president, as it was chiefly through his efforts that the society was founded. Bowman, because of his earlier investigations into the anatomy and physiology of the kidney, was deemed, in the parlance of the time, to be the "Father of the Kidney"; he might also be considered as the "Father of British Ophthalmology."

At another meeting a set of rules was adopted which were subscribed to by a list of 63 members. An inaugural meeting was held in October. The membership doubled by further admissions. The youthful organization comprised such well known men as George Critchett, Hughlings Jackson, Jonathan Hutchinson, Argyll Robertson, Brailey, Brudenell Carter, Thomas Buzzard, Couper, Nettleship, Gowers and Waren Tay. At the end of the first year the ordinary members numbered 141, and Donders and Helmholtz were elected to honorary membership.

During 1880 eight meetings were held in the rooms of the Medical Society of London on Chandos Street. Color blindness, the relation

between optic neuritis and intracranial disease, the ocular symptoms in locomotor ataxia and retinal hemorrhages associated with high arterial tension and also occurring in patients suffering from pernicious anemia were among the topics discussed. Tay reported a case under the title, "Symmetrical Changes in the Region of the Yellow Spot in Each Eye of an Infant." McHardy exhibited "electromagnets for the detection and removal of fragments of iron and steel from within the eye."

The society immediately became the rallying ground of the best practitioners and students in the United Kingdom and soon began to attract the attention of the medical world. At the end of the second year 158 members were enrolled, and the communications numbered 71.

Jonathan Hutchinson succeeded Bowman as president and maintained his membership for years, constantly contributing to the *Transactions*. He presided over the society for three years. In his valedictory address he called attention to the progress which was then being made toward accuracy in clinical and pathologic knowledge, and he lauded the introduction of cocaine, which was used as a local anesthetic at Moorfields for the first time in September 1884.

In 1883 two events of great importance to the society occurred. The Medical Society had made extensive improvements in the premises and, in consequence, the rent for the rooms used by the Ophthalmological Society was increased. The finances of the society were found to be inadequate for that added expense. Bowman generously undertook to bear the cost of all fittings necessary for a museum and library, besides making a gift of £50 annually for twenty years! These benefactions placed the society in a sound financial position. A library was founded in 1884 with about 100 books and continued to increase both in size and in importance. In 1887 a catalog was published under the direction of Adams Frost, who should be remembered for his "Atlas of the Fundus Oculi"; Frost continued as librarian for several years.

The society sought from the beginning to influence the medical authorities to regard ophthalmology as a legitimate specialty, yet it was not until 1891 that courses in the fundamentals of ophthalmic medicine and surgery were established in the medical schools, so from that date all students have been required to attend hospital clinics and courses of systematic lectures on ophthalmology.

It was significant in this respect that Mr. Argyll Robertson, who became president in 1893, referred to the great service which ophthalmology had already rendered to general medicine and surgical therapeutics and pleaded for a firm union of ophthalmic specialists with each other and with general practitioners. Nettleship urged that specialists should be attached to special hospitals.

At the suggestion of Dr. William Gowers, an active member for years, the Bowman Lecture was founded, quite without the knowledge of Bowman, in commemoration of his valuable service to the Ophthalmological Society and in recognition of his distinguished scientific position in ophthalmology and in other branches of medicine. The lecture was to consist of a résumé of recent advances in ophthalmology or of any original investigation, to be delivered at a special meeting called for that purpose only. The first lecture was delivered by Jonathan Hutchinson on Nov. 13, 1884, his subject being "On the Relation of Certain Diseases of the Eye to Gout."

There have been 28 Bowman Lectures. Among the foreigners who have delivered them have been Zehender, Hansen Grut, Leber, Snellen, Fuchs, Sattler, Landolt, Uhthoff, Morax, de Schweinitz and Van der Hoeve.

The interest of the society was aroused early in the prevention of blindness from ophthalmic neonatorum, and it was urged that the attention of the medical press and those engaged in the practice of obstetrics should be called to this important matter. A legal enactment compelling local government boards to warn against the dangers of the disease was sought. But the society was advised that there was no legal power yet established by which the local boards could compel attention to the danger, although boards of guardians had always shown a readiness to comply with the suggestions presented for the health of the sick.

In the spring of 1892 the society met a severe loss in the death of Sir William Bowman. So vitalizing had been Sir William's influence and patronage over the society that at his passing there seemed to have been created a hiatus the contemplation of which caused the members to pause and consider how they might be able to go on in the future without his companionship. Hansen Grut, of Copenhagen, when introduced as the lecturer in 1890, said:

> Those of an older generation had had one great advantage not enjoyed by his younger colleagues, for they had witnessed the glorious dawn of modern ophthalmology. In the older men's first years of study and practice they were led by such geniuses as von Graefe, Donders, Arlt, von Jaeger, Critchett and, besides many others, Sir William Bowman, who had always stood as the great example to the practitioners of ophthalmology. Foreigners fully understood and shared the unparallelled love and admiration which was bestowed upon Bowman by his countrymen, for he had served for years as the glorious illustration of what the great men of the grand period of Ophthalmology were like.

In 1901 the Edward Nettleship Prize for the encouragement of scientific ophthalmic work was inaugurated by the friends and pupils of Nettleship. The prize consists of a gold medal and has been awarded at intervals of three years. In addition to provision for the medal, surplus funds are used in the purchase of works for the library.

In 1913 the library was housed in a separate room in the quarters of the Royal Society of Medicine, and the additional privilege of holding meetings in its rooms was extended to the Ophthalmological Society.

The dues of the society were originally 1 guinea, but in 1920, owing to the increased cost of the *Transactions*, the dues were increased to 1½ guineas. An Illustration Fund was formed to relieve authors of this expensive item in the publication of their contributions. The *Transactions* have been published annually, and besides the individual indexes, additional complete indexes have been prepared at intervals of ten years.

There had been agitated for several years the proposition that the ophthalmologic section of the Royal Society of Medicine should unite with the Ophthalmological Society, but in 1912 it was decided that no such union should be formed because the society was unwilling to lose its identity and its independence.

In 1917 it was decided that other ophthalmologic societies in the British Empire might become affiliated and that their proceedings might be published in the *Transactions*. The *Transactions* of 1919 contained

reports of five affiliated societies: the Oxford Ophthalmological Congress; the Midland, the North of England and the Irish Ophthalmological Society, and the Ophthalmological Society of Egypt. Later, the Scottish Ophthalmological Club was added to the group. In 1924, when Egypt became a sovereign state, the Egyptian Ophthalmological Society was no longer affiliated. In 1927 the South Western Ophthalmological Society became affiliated.

The meetings have usually been held in London, but Glasgow, Liverpool and Edinburgh have been honored. In the early years of its existence, the meetings of the society were held several times in the year, but in 1913 it was decided to hold an annual meeting of several days' duration. In 1925 the meeting took the form of a convention of English-speaking ophthalmologic societies. At this convention the minister of health and the American ambassador made addresses, and there was presented to the society the Critchett Memorial Presidential Badge, to be worn by the president of the society, offered by the family in memory of George Critchett and Anderson Critchett, father and son. Mr. Treacher Collins, the incumbent of that year, who had been largely instrumental in the success of the convention, was the first to wear the badge. In addition to the interesting and comprehensive program, the members visited the institutions in London, and at night a dinner was held at the Guild Hall. At a general meeting a committee was appointed to obtain cooperation for the promotion of international congresses, and this led to the resumption of the congresses which had been discontinued during the World War.

In 1932 the society lost one of its most distinguished members, Mr. E. Treacher Collins; he had been president twice, had been a Bowman lecturer and had received the Nettleship Medal. He bequeathed £500, which has been added to by subscriptions by others for funds for the Treacher Collins prize essay.

A fifty years jubilee was celebrated at the annual congress of the society in London in 1930, at which many distinguished foreign ophthalmologists were guests. The Bowman Lecture was delivered by Sir Arthur Keith, who proclaimed Bowman as one of the greatest anatomists England has produced.

That the society, which is active and virile, will take as important a part in "the cultivation and promotion of ophthalmology" in the future as it did in the past is assured by the membership composing it. According to Dr. Cargill, in 1937 there were besides life and honorary members, 571 general members. Only one original member, Sir Lindo Ferguson, of New Zealand, was still living.

Society Transactions

EDITED BY W. L. BENEDICT

FRENCH OPHTHALMOLOGICAL SOCIETY

Fifty-First Congress, Paris, May 16-19, 1938

First Session, May 16

DOUBLE TREPHINING WITH THE AID OF A TREPHINE WITH A MOVABLE CROWN IN DACRYORHINOSTOMY (Lantern Slides). J. SUBILEAU, Paris.

The success of dacryorhinostomy depends to a large extent on the correct trephining of the lacrimal duct. The trephining should be wide. The author uses a trephine inspired by the two trephines of Arruga, which he combines into a single instrument. A crown with teeth slides around a cylinder furnished with a catch, which serves as a pivot. The crown is automatically locked by means of a bayonet device. In the first position the central pivot slides forward and passes the teeth. It rests on the bone to permit the making of a tracing. In its second position the pivot disappears, and trephining is accomplished by driving the crown into the tracing line. The diameter of the trephine is 8 mm.

The author prefers a double trephining, one opening being overlapped on the other more or less according to the size of the lacrimal sac, to the single trephining, with which one runs the risk of leaving the bony promontories obstructing the operative incision by hindering the eversion of the lips of mucous membrane. With the double trephining the opening is the shape of an 8. It is completed in front by the aid of a Citelli forceps. The method permits a more rapid operation and has the advantage of sparing the patient the shock due to the use of the chisel and mallet.

ROENTGEN THERAPY FOR MEIBOMIAN EPITHELIOMA. PIERRE DUPUY-DUTEMPS, Paris.

Roentgen therapy was used successfully in 2 cases of meibomian epithelioma. The cure was of long enough duration to be considered permanent.

Though wide excision at the onset remains the best means of treating cutaneous epithelioma of the ocular region, it seems that the application of the roentgen rays is the method of choice for glandular epithelioma of the eyelids.

SYMMETRIC LYMPHOMA OF THE TWO SEMILUNAR FOLDS: A SYMPTOM INDICATIVE OF LYMPHATIC LEUKEMIA (Lantern Slides). MARCEL KALT and H. TILLÉ, Paris.

A man aged 66, in good health, who sought consultation for watering of the eyes, was found to have a purplish blue tumor the size of a bean at the level of each semilunar fold; the growths did not involve

the caruncle and extended under the epithelium of the conjunctiva of the inner cul-de-sac. Biopsy of the growth on the right revealed it to be a typical encapsulated lymphoma. Three other lymphomas existed under the buccal mucous membrane. There was moderate polyadenopathy, and the spleen was hypertrophied. Chemical studies of the blood revealed lymphatic leukemia with leukocytosis, the white cell count being 65,000 (92 per cent large and medium nongranular mononuclear cells and 3 per cent lymphocytes).

Since the patient's general condition was good, treatment with an arsenic preparation was given for a month. Three weeks after its discontinuance, there appeared another lymphoma of the right bulbar conjunctiva, bilateral hemorrhages of the retina (without leukemic retinitis), epistaxis, purpura, asthenia, an increase of the adenopathy and the splenomegaly and an increase in the globular anemia and the leukocytosis. In view of this disturbance in equilibrium, roentgen therapy of the spleen and of the ganglions was indicated—a two-edged weapon that had been kept in reserve on the advice of Dr. Pagniez.

The development of the leukemia in this case and the fate of the semilunar lymphoma on the left side (left as a control) will be published subsequently.

EXPERIMENTAL STUDY OF THE CICATRIZING ACTION OF INSULIN ON CORNEAL WOUNDS. C. DEJEAN and P. ARTIÈRES, Montpellier.

This study was made on 34 rabbits of an average weight of 3,000 Gm. It consisted in comparing the rapidity of corneal cicatrization in groups of rabbits, some of which were subjected to therapy with insulin while the others served as controls. The same type of corneal wound was made in all the animals by means of Elliot's trephine. The conclusions of the authors are as follows:

1. In the case of a rabbit weighing 3,000 Gm. with a loss of superficial corneal substance a daily injection of from 10 to 15 units of insulin advances by two to four days the cicatrization of a superficial corneal defect with regular edges.

The addition of sugar to insulin is necessary to avoid hypoglycemia.

2. Under the same conditions a dose of 5 units is insufficient to activate cicatrization.

3. Local applications of insulin in an ointment do not seem to accelerate cicatrization under the conditions mentioned.

HYPOPYON KERATITIS AND HYPERTONIA. A. MOTOLESE, Florence, Italy.

The author reports experiments which confirm the role of hypertonia in the development of hypopyon keratitis.

In their entirety, the results of these experiments prove that hypertonia plays one of the most important roles in the development of hypopyon keratitis.

In fact, the author was able to show that the progress of the corneal ulcer was accelerated by the hypertonia which was induced experimentally; that in all the cases considered more or less complete destruction of the cornea was observed, whether virulent germs previously taken from pure cultures or less virulent germs previously taken from recent cultures were employed; and finally that the ulcer could be made worse by the induction of hypertonia during its development.

The treatment which Bardelli ordinarily applies to this disease in the ophthalmologic clinic of Florence is reported.

INFLUENCE OF RADIUM ON INTERSTITIAL KERATITIS (Lantern Slides). W. J. KAPUSCINSKI, Posen, Poland.

The action of radium on the course of interstitial keratitis manifests itself by the following signs: (1) rapid vascularization and just as rapid disappearance of newly formed vessels, (2) reappearance of opacities after their initial disappearance, (3) dispersion and migration of the opacities and (4) clearing up of the cornea, at times rapid and permanent.

The best dose is 66 mg. of radium element with a filter of 1 mm. of platinum at a distance of 2 cm. for six hours. This dose does not injure the cornea.

SURGICAL TREATMENT OF DISEASES OF THE CORNEA. R. RUBBRECHT, Brussels, Belgium.

The method recommended is applicable to most of the superficial diseases of the cornea, that is, those which concern only the epithelium and the anterior lamellae of the parenchyma. The operation consists in excising the diseased corneal focus and in covering the loss of the substance thus caused by means of a thin section taken from the bulbar conjunctiva. This section should be limited as much as possible to the epithelial bed. The esthetic and visual results will be all the better in that the subepithelial dermal bed is thinner. By this operation one can rapidly and permanently heal stubborn corneal lesions. The transplanted section constitutes a solid protection, preventing recurrence. It is compatible with a high degree of transparency.

DEVELOPMENT OF KERATOCONUS (Lantern Slides). MARC AMSLER, Lausanne, Switzerland.

Keratoconus is regarded as an evolutive and progressive condition. Of a total of 42 patients (from which group are excluded those with keratoconus classified as of the fourth degree) followed during a period of from two to nine years, only 6 showed an increase in the characteristic deformation on keratography. There was a gradual progression of keratoconus, occurring at different ages (about 25, 30, 40, 50, 53 and 60). In the great majority of instances the latent or mild keratoconus has been found to be stationary, at least within the limits of the time of observation.

Keratoconus of the fourth degree often gives rise to more or less inflammatory and acute changes, which, however, are incidental, transitory and curable.

FIBROMA OF THE SCLERA (Lantern Slides). M. TEULIÈRES and J. BEAUVIEUX, Bordeaux.

The authors report the case of a 5 year old child afflicted with a fibroma of the sclera, which had probably originated in the tendon

of the superior rectus muscle, the rapid evolution of which had suggested that it was a malignant tumor.

At operation a tumor the size of a small chestnut, intimately united to the sclera in its anterior portion, was excised through the upper cul-de-sac of the conjunctiva. The shape and movements of the eyeball and the visual acuity were restored.

The anatomicopathologic examination revealed that the growth was a pure fibroma.

IRITIS AND FOCAL INFECTION: ALLERGY; RETICULOENDOTHELIAL SYSTEM; CLASOGÉNINES (Lantern Slides). HENRI LAGRANGE and JEAN GOULESQUE, Paris.

The pathogenic problem raised by the localization and subordination of certain pathologic reactions occurring as manifestations of a latent infectious focus is considered. Reactions such as these produce forms of iridocyclitis which constitute the nosologic group of iridocyclitis due to focal infection. The authors show that the condition is a manifestation of tissue allergy, the localization of which is determined by the presence at the level of the ciliary processes of an important reticuloendothelial cellular colony.

HEERFORDT'S SYNDROME: A SPECIAL FORM OF A NEW EXTENSIVE RETICULOENDOTHELIOSIS; BESNIER-BOECK-SCHAUMANN DISEASE. L. M. PAUTRIER, Strasbourg.

Pautrier points out that the syndrome of uveoparotitis, called Heerfordt's syndrome, has been considered until now as an essentially ophthalmologic disease, in spite of the syndrome of infectious parotitis, which forms part of it, and of the different symptoms associated with it, that is, recurrent facial paralysis and cutaneous eruptions, to which until now no one has called attention systematically and above all connected with the same process.

Pautrier has been able to prove in a series of recent publications that in reality the syndrome of Heerfordt should be placed in the category of a new extensive reticuloendotheliosis isolated by dermatologists, called Besnier-Boeck-Schaumann disease, of which it constitutes only a special form. For the support of his argument he recalls a recent case which he reported in the *Bulletins et mémoires de la Société médicale des hôpitaux de Paris* (**53**: 1608 [Dec. 20] 1937) as well as the cases of Lesné and Coutela, of Lamy and of Paufique. The authors seem, indeed, to agree with reference to the classification.

Besnier-Boeck-Schaumann disease is characterized by cutaneous sarcoid eruptions and pulmonary, ganglionic, osseous, glandular, visceral, ocular and neural lesions. Its manifestations may be distributed in the whole reticuloendothelial system. The lesions, wherever their site, have a constant anatomicopathologic unity and are made up of squamous epithelioid cells, at times with the addition of giant cells but without tuberculous follicles, foci of caseation or the presence of the bacillus of Koch.

The same histologic structure is present in this disease that is present in Heerfordt's syndrome, in parotitis, in uveal lesions and in neural

lesions. The identity of the two clinical and histologic types is beyond doubt.

The tuberculous origin scarcely seems likely because of the spontaneous healing of all these lesions. If vision at times remains impaired in Heerfordt's syndrome, it is because of the complexity and delicacy of the eye, which cannot meet the requirements for complete recovery. It seems more probable that the disease is caused by a virus which is yet to be isolated. Additional researches are necessary to determine the cause.

POST-TRAUMATIC PEARLY CYST OF THE IRIS: INCLUSION OF AN EYELASH IN THE ANTERIOR CHAMBER (Lantern Slides). M. TEULIÈRES and J. BEAUVIEUX, Bordeaux.

A pearly cyst, similar to those which Masse has been able to produce experimentally, developed on the anterior surface of the iris after the penetration of an eyelash into the anterior chamber at the site of an accidental wound.

The cyst when removed showed the normal structure of tumors of this kind; that is to say, the cavity was lined with stratified pavement epithelium of the malpighian type.

ENTOPTIC PUPILLOSCOPY: SPONTANEOUS VARIATIONS OF THE PUPILLARY DIAMETER. HENRI VIALLEFONT and R. LAFON, Montpellier.

By the entoptic method, Viallefont and Lafon have established the fact that in the absence of exciting factors the mean diameter of the pupil is constantly variable, these variations being absolutely independent of the pulse, of respiration and of psychic modifications. A graphic representation of the pupillary diameter would be expressed as an irregular broken line.

Second Session, May 17

SHOCK THERAPY IN OPHTHALMOLOGY. L. HAMBRESIN, Brussels, Belgium.

The work of Hambresin is divided into four extensive parts. In the first part he deals with the phenomena of shock. Shock is a physiologic imbalance the beginning and termination of which are abrupt. It rests only on functional disorders and is not followed by any lasting anatomic lesion. Occurring under many circumstances, it has a clinical picture which is far from being univocal. However, there exists always a disturbance of the blood, resulting in what is called the hemoclastic crisis, the principal symptoms of which are arterial hypotension and leukopenia.

The second part has reference to shock therapy, which aims at checking the evolution of a disease by provoking an artificial crisis, an artificial shock. One speaks of great shock, of attenuated shock, of "formes frustes" of shock and even of local shock, according to the importance of the phenomena which accompany it.

Shock therapy is of use for two groups of pathologic conditions. The first group consists of all diseases which show at the beginning a state of plasmatic instability, such as hemophilia, paroxysmal hemo-

globinuria and anaphylaxis. In the presence of such conditions shock reestablishes normal equilibrium. It serves as a desensitizing measure. The second group includes the infections. In cases of such conditions the secondary effects of shock are utilized to check the progress of the disease; in such cases shock treatment actually increases the defense of the organism.

In the third part all the agents of therapeutic shock are reviewed. The substances which are currently employed are the organic substances (peptone, milk and blood), metals and metalloids in the colloidal state (sulfur, silver and gold) and microbes. All the vaccines contain microbes. In the field of ophthalmology one makes special use of dmelcos (a vaccine of Ducrey bacilli), of Renard's vaccine, of propidon (a mixed stock vaccine prepared by the method of P. Delbet) and of the vaccine triple V (a bacterial vaccine containing the organisms of typhoid and the two paratyphoids).

After having explained in detail the use of all these products, the author takes up the "fixation abscess," which is considered by many clinicians as a method of shock therapy. The waste products resulting from the disintegration of the tissues become heterogeneous albumins, the reabsorption of which produces humoral modifications. He has also reserved a paragraph for pyretotherapy, which often only determines shock phenomena, and to a study of injections of charcoal suspension.

In ocular therapy use is made of all these agents, except peptones, by the intravenous route. However, most often milk is employed, milk brought by the milkman and not the substitutes placed on the market by manufacturers of pharmaceutic products, which are all less active. The milk should be fresh. It should be boiled for from eight to ten minutes and injected at once after boiling, as soon as it has returned to normal body temperature. The injection is made under the skin at the level of the flank. Five cubic centimeters is used for the first injection. According to the results obtained, one continues to use this quantity or to increase the dose. The amount used should not exceed 10 cc. From three to four injections are made at intervals of two or three days. In view of the sensitivity of certain patients, it is always prudent to make a preliminary injection of 1 cc. an hour before the first puncture.

The principal contraindications to milk therapy are tuberculosis, cardiac diseases and arteriosclerosis. Neither is the method justified in a case of pregnancy. As for accidents, the formation of abscess, manifestations of delirium and the phenomena of anaphylaxis may occur. The literature records also some fatal cases. The study of these cases shows that in infants there were several recurrences of tuberculous lesions and that the death of adults should be ascribed either to shock or to infection. In the cases in which shock seems to have been the cause of death, the patients were always asthmatic.

The last part of Hambresin's work is reserved for the study of ocular diseases treated with shock. Almost all ophthalmologists make use of this method. The successes reported are numerous and include the most varied diseases. One can say, nevertheless, that the best results are obtained in the diseases of the anterior segment of the eye. The

main conditions in which the treatment is indicated are: gonorrheal conjunctivitis, hypopyon ulcer, iritis, cyclitis and infected wounds. Among these indications, the blennorrhagic inflammations of the conjunctiva are the principal ones. Milk is the best shock-producing agent in cases of gonorrheal conjunctivitis in adults. In case of corneal complication, treatment with milk should be instituted at the onset. As for gonorrheal conjunctivitis of newborn infants, in the opinion of many authors therapeutic shock is far less satisfactory.

Galactotherapy often works wonders for the keratoconjunctivitis of infancy. It diminishes the reactive phenomena of parenchymatous keratitis. In the treatment of sympathetic ophthalmia it seems that injections of milk should give way to injections of turpentine.

As to his conclusions, the author insists first of all on the fact that the production of shock is not a specific treatment. Its essential mechanism is unknown. It probably involves an extremely complex action. Shock seems to give a stimulus which puts into play the defense mechanisms of the organism, among which the reticuloendothelial system occupies one of the first places. Although one might say that focal reaction constitutes the main point in the therapy, hyperthermia is useful. The finest results are obtained, without doubt, when there has been a high fever. In a general way, the results of shock therapy are much more favorable in acute localized processes than in acute generalized diseases. The method, however, offers interesting results in chronic diseases, especially when they are confined to an infectious focus. The fact that the lesion is localized constitutes, accordingly, a favorable condition for success. It is thus that the numerous successes in the treatment of ocular diseases are explained.

DISCUSSION

E. AUBINEAU, Nantes: Dr. Hambresin is right in considering even inactive tuberculosis as a contraindication of shock therapy. I should like to call his attention to the case of a girl of 18 years afflicted with "recurring retinal hemorrhages" and with pleurisy of long standing, who was treated with shock by means of injections of serum. Good visual results were obtained, but pulmonary tuberculosis developed, clearly as a result of the shock, and death ensued.

LONG AND EXTENSIVE EXPERIENCE WITH SHOCK TREATMENT BY INTRAVENOUS INJECTION OF ELECTRAUROL. A. JACQUEAU, Lyon.

Jacqueau has given more than 3,000 intravenous injections of electraurol (a proprietary electrocolloidal gold solution). He has never had an accident or even an untoward occurrence. The dose employed has always varied between 2 and 5 cc. This dose can be repeated on several consecutive days. Noticeable shock is often absent. The injection is painless.

The indications are those for humoral therapy, called shock therapy. Patients operated on for cataracts are the first to benefit by the treatment. One must act promptly at the least suspicion of endogenous infection, even at the least indisposition of the patient. In cases of infectious iritis with hypopyon and in cases of disturbances of the vitreous of the same nature, its action is rapid and effective. The same

holds good for intraocular infection resulting from sclerectomy. The indication is clearcut in cases of ocular perforations with menacing panophthalmia. Sympathetic ophthalmia seems to be much improved by prolonged treatment. Inflammatory lesions of the corneal or the scleral wall and lesions of the eyegrounds are not influenced or scarcely so.

TYPHOID VACCINE IN OCULAR THERAPY. W. J. KAPUSCINSKI JR., Posen, Poland.

After having briefly reviewed the literature on the use of typhoid vaccine in ophthalmology, the author describes his own researches and conclusions based on the treatment of 50 patients with this vaccine. The author describes in detail the technic of the treatment necessary to obtain a temperature fluctuating between 39 and 40 C. (102.2 and 104 F.) or even higher. Thereupon he presents the blood pictures, including the arterial tension and the number of leukocytes. The conclusion is that the changes are due only to the fever. There does not exist the least sign of shock or of an allergic reaction after the use of heterogeneous protein. Therapy with typhoid vaccine is, in its strict sense, pyretotherapy.

The following are the final conclusions:

1. Typhoid vaccine induces a high fever.

2. The ratio between the dose of typhoid vaccine and the temperature depends on the discretion of the physician.

3. The intravenous injection of the typhoid vaccine several times with an interval of several months between injections never induces shock.

4. The value of pyretotherapy with typhoid vaccine is considerable. The author recommends this as the fundamental and principal treatment in cases of acute uveitis, especially of the sympathetic type; in cases of retinitis or ophthalmia of unknown origin; in cases of gonorrhea, and in cases of traumatic iritis. In many other infectious diseases of the eyes, especially those produced by focal infections, typhoid vaccine acts as a strengthening therapy, accelerating the process of recovery.

Third Session, May 18

HISTOSPECTOGRAPHY AND MICROINCINERATION OF THE NORMAL AND PATHOLOGIC CRYSTALLINE LENSES AND ESPECIALLY OF BLACK CATARACT. H. TILLÉ, P. PILLET and G. BUSNEL, Paris.

The application of histospectography and microincineration, perfected by Policard, to the histochemistry of crystalline lenses, including all those from the normal lens to the lens with black cataract, showed the following facts:

1. There was absence of iron, copper and zinc in appreciable quantities. A minute trace of iron was found in the normal crystalline lens, in the white senile cataract and in the amber-colored senile cataract.

2. There was a clear presence of copper, not yet pointed out by various authors, in 2 cases of black cataract. The copper had its site in the nucleus.

3. The presence of iron was demonstrated in the black cataracts, with topographic peripheral predominance.

4. All lenses showed an absence of zinc.

5. Some rare melanophores were found in the black cataract of adults.

6. The results of tests for pigmentation of the red blood cells were negative; the study of the hematoporphyrins with the microspectroscope and the microfluoroscope did not reveal the existence of these pigments in any case.

ORIGINAL TECHNICS FOR REMOVAL OF THE CRYSTALLINE CATARACT (Lantern Slides). HENRI LAGRANGE and JEAN GOULESQUE, Paris.

Films were shown demonstrating how by the combined action of the instrument used to take hold of the crystalline lens (a cupping glass or a forceps) and an instrument for counterpressure to be applied below the cornea (a *butoir*) it is possible with a cupping glass or with a forceps to break the zonula at the level of its lenticular but not its ciliary attachment and to remove the lens with the Henri Lagrange forceps without recourse to a version capable of tearing the hyaloid membrane. Two procedures for the protection of the wide keratotomy (systematic conjunctival covering or a conjunctival bridge, with a wide flap) were also demonstrated.

THREE SAFE METHODS OF FACILITATING TOTAL EXTRACTION OF CATARACT (Lantern Slides). C. DEJEAN, Montpellier.

The total extraction of cataract is facilitated when the patient looks down. This position is obtained by retrobulbar injection of procaine hydrochloride directed toward the superior rectus muscle at the union of its middle third with its posterior third. It is there, according to the author's investigations, that the ramifications of the motor nerve touch the muscle. The same injection can reach the ciliary ganglion and the ciliary nerves, abolishing sensation in the eyeball.

The danger of loss of vitreous in the course of the operation will be averted by hypotonia of the eyeball. This hypotonia can be achieved by retrobulbar injection. However, there are modifications in the time and individual variations. The study of these variations allows one to form the conclusion that surgical intervention ought to be begun ten minutes after the injection. Nine times out of ten this is the moment of election.

Finally, the suture of the cornea with the Gomez-Marques stitch, slightly modified, adds still more to the safety of this brilliant operation.

THE VALUE OF TOTAL EXTRACTION OF THE CRYSTALLINE LENS. P. BONNET and L. PAUFIQUE, Lyon.

The authors discuss the advantages of total extraction of the crystalline lens in connection with 2,000 operations.

1. In cases of uncomplicated senile cataract, total extraction offers the advantage of permitting operation from the time that visual discomfort hinders reading. It offers an infinitely better functional result.

The advantages of the operation are not counterbalanced by greater risks. If the operation requires more minute precautions, a more delicate technic and a more rigorous supervision, total extraction does not, on the other hand, lead to more risks in the course of the operation or to subsequent special complications. Complications, such as detachment of the retina and delayed disturbance of the vitreous, call attention to pathologic cataracts.

2. For pathologic cataracts (cataracts associated with high myopia, subluxated cataracts, black cataracts, cataracts with descemetitis and cataracts of diabetic persons) the results obtained by total extraction are better, because the operation guards against postoperative ciliary reaction.

3. For unilateral cataract, for the same reason, it is the operation of choice.

NEW SERIES OF RESULTS OF TOTAL EXTRACTION OF CATARACT: PRIME IMPORTANCE OF PREOPERATIVE AND POSTOPERATIVE CARE (Lantern Slides). R. DE SAINT-MARTIN, Toulouse.

The results obtained with 217 cataract extractions performed serially are reported. The patients were reexamined at least once after six months. The author compares these results with those obtained with 643 total extractions, the report of which was published in the transactions of this society in 1935 (ARCH. OPHTH. **14**: 1044 [Dec.] 1935) to show their agreement and constancy.

Total accurate extractions have succeeded, respectively, in 91.56 and in 74.78 per cent of the cases in the first and second series. Superior visual acuity, of 5/10, has occurred in 82.49 per cent of the new series and in 84.94 per cent of the old series. Acuity has improved with time (from six months to two years and more) in 86.4 per cent of the new series and in 84.94 per cent of the old series. It has diminished in 2.32 per cent of the cases of the new series and in 8.43 per cent of the cases of the old series. The accidents for which certain critics make the method particularly responsible and which according to them are sufficient to discredit it are: detachment of the retina and progressive and late disturbance of the vitreous, which occurred in the total of 860 extractions, retinal detachment occurring in 1.04 per cent, and disturbance of the vitreous in 5.23 per cent. (The last-mentioned occurrence has its source most often in former iridochoroiditis and myopic flakes.)

Results such as these, identical with those published for more than ten years by the best European and American surgeons, are sufficient to establish the superiority of total extraction. Good results cannot be obtained except by the strict observance of preoperative and postoperative precautions, which the author enumerates and which concern, respectively, the digestive, the circulatory and the nervous system.

SYSTEMATIC CONJUNCTIVAL COVERING IN THE OPERATION FOR COMPLICATED CATARACTS. H. VILLARD, Montpellier.

The author advises that the classic operation for removal of cataract be completed by entirely covering the corneal wound with conjunctiva

in all cases of cataract in which failure is particularly to be dreaded because of abnormal septic conditions.

The ideal protection of the wound by the mucous membrane of the conjunctiva permits the saving of eyes which without this precaution seem doomed to an almost fatal infection. The excellent results obtained in those operated on urged him to employ a similar precaution in cases in which a loss of vitreous was almost certain (cases of luxated or subluxated cataracts and secondary cataracts subjected to removal). Here, too, the results were remarkable.

Ocular Tension, Glaucoma and Hypophysis. P. Jeandelize, P. L. Drouet, C. Thomas and Bardelli, Nancy.

The authors draw the following conclusions:

1. There may be coexistence of ocular hypertension and certain hypophysial diseases.

2. Certain diseases of the pituitary gland of the hyperfunctioning type (acromegaly) or certain condition such as pregnancy, in the course of which the hypophysis undergoes important modifications, engender ocular hypertension.

3. Hypophysial extracts seem to have a hypotensive effect in cases of glaucoma.

4. The experimental data confirm the hypotensive effect on the eyeball of the injection of posterior pituitary extract and the hypertensive effect of hypophysectomy.

The facts do not permit further conclusions. New researches will be necessary to specify the constancy of the hypotensive effect of the extract of the posterior lobe, the least concentration to be used to obtain a certain effect, the mechanism of this hypotension and the clinical types of glaucoma in which therapeutic indication will seem most effective.

Attempted Treatment of Chronic Glaucoma Through Acidification of the Vitreous Body. E. Redslob, Strasbourg.

The author criticizes therapeutic attempts to diminish glaucomatous hypertension by lowering the p_H of the vitreous. He bases his stand on experiments made in collaboration with Reiss in vitro and on the rabbit. The experiments showed, in fact, that a slight lowering of the p_H of the vitreous considerably diminishes its state of distention.

He uses, as previously, a 0.7 per cent solution of phosphoric acid. This solution is perfectly tolerated by the vitreous and the entire eyeball. The same holds good for a 2 per cent solution.

The author reports his observations on 6 cases of absolute glaucoma in which this treatment was used. In all the cases there was an appreciable diminution of intraocular tonus. In 3 cases it was transitory, persisting for only about fifteen days. These half-measures were observed only in persons whose general condition was strongly affected. In the other 3 cases the effect of acidification of the vitreous body was satisfactory, whereas previous operations combined with an intensive treatment with miotics had failed. After one or two injections of acid, the tonus returned to normal and remained there for several months.

What is curious is that the miotics, without effect before the injection, had an undeniable effect after the injection.

Attempts will be made in cases of less advanced glaucoma.

MELANOCARCINOMA OF THE EYE. H. MOUTINHO, Lisbon, Portugal.

The author made an anatomicoclinical study of 9 cases of melanocarcinoma of the eyeball. Three of the growths were epibulbar, and 1 was in the iris, 1 in the ciliary body and 4 in the choroid. He establishes the preexistence of nevi in the external tumors and the coexistence of the pigmented spots of former chorioretinitis in the tumors of the choroid and accepts as the origin of the malignant melanomas a more or less apparent pigmented spot; hence the designation of melanocarcinoma to embrace the nevocarcinomas and the tumors of the choroid the nevic origin of which is not always demonstrable.

Concerning the origin of the pigment which always exists in a more or less apparent fashion, even in the leukosarcomas, the author demonstrated the endocellular formation of melanin in the culture of melanosarcomas which he undertook.

As to the histologic nature and unity of melanocarcinoma in their varied structure, the author makes a comparison between the various verified histologic aspects and the various zones of a conjunctival nevus in growth, as Masson had done for cutaneous nevocarcinomas, thus admitting the original unity of the melanomas in the epithelial melanoblast of the skin, of the conjunctiva or of the pigmentary epithelium of the retina.

Fourth Session, May 19

RATE OF BLOOD FLOW IN THE RETINAL VESSELS. M. FRITZ, Brussels Belgium.

The simultaneous observation of the vascular calibers and of the flow of blood by the technic of the artificially produced venous granular current makes possible the appraisal of the rate of blood flow at the level of the retinal vessels.

The normal rate is that which corresponds to an arterial or venous caliber of the retina of 0.1 mm. in diameter and to a flow of blood that allows the granular venous current to appear at seven tenths of arterial collapse.

A reduced vascular caliber associated with an exaggerated flow of blood indicates an abnormally fast rate. On the contrary, an exaggerated vascular caliber and a reduced rate of flow indicates a decrease of blood and predispose to thrombosis.

The rate of blood flow at the level of the capillaries can equally be ascertained to a certain degree by the simultaneous appraisal of the flow of blood and the condition of capillary permeability, indirectly appraised by the degree of venous pulsation and the intensity of the coloration of the papilla.

ANGIOID STREAKS OF THE RETINA, THE RED MARKS OF THE VITREOUS LAMELLA OF THE CHOROID: THEIR RELATION TO PSEUDOXANTHOMA ELASTICUM OF THE SKIN AND TO VASCULAR DEGENERATION OF THE CHOROID; PROGRESSIVE CHANGES OF THE MACULA (Lantern Slides). P. BONNET, Lyon.

The author reports 2 cases of angioid streaks of the retina. He describes the morphologic aspect of the streaks and recalls the changes in the macula and their development, referring to the articles which he published in the *Archives d'ophtalmologie* (**50**: 721 [Nov.] 1933; **52**: 225 [April] 1935).

He points out the relation of angioid streaks to pseudoxanthoma elasticum of the skin and to the degeneration of the vascular plexus of the choroid.

He believes that retinal angioid streaks correspond to cracks and red marks of the vitreous lamella of the choroid.

CIRSOID ANEURYSM OF THE RETINA (RACEMOSE ANEURYSM): ITS RELATIONS TO CIRSOID ANEURYSM OF THE FACE AND CIRSOID ANEURYSM OF THE BRAIN. P. BONNET, J. DECHAUME and E. BLAND, Lyon.

The authors, basing their opinions on two observations, call attention in *Le Journal de médecine de Lyon* of March 20, 1937 (page 165) to an anatomicoclinical complex characterized by the coexistence of retinal cirsoid aneurysm with facial cirsoid aneurysm and an intracranial cirsoid aneurysm.

A closely allied complex of retinal angiomatosis (von Hippel's disease) associated with angiomatous cysts of the brain (Lindau's disease) is considered.

The authors think that a visual disturbance, if it exists, should draw attention to the intracranial lesion.

They formulate the following conclusions:

1. In the presence of retinal cirsoid aneurysm, accidentally observed, the existence of cirsoid aneurysm of the face should be systematically looked for. A neurologic examination should be made, directed toward the search for a cirsoid aneurysm of the brain.

2. The presence of any vascular malformation of the face should lead to an ophthalmologic and a neurologic examination.

3. In the case of a cerebral disease, the ophthalmologist, examining the eyeground, should bear in mind the existence of cirsoid aneurysm of the retina.

THROMBOSIS OF THE CENTRAL VEIN OF THE RETINA. H. COPPEZ and A. FRITZ, Brussels, Belgium.

The authors analyze 2 cases of thrombosis of the central vein of the retina, in which the ophthalmoscopic aspects were identical but the mechanisms of development of the condition were essentially different.

In the first case there was generalized hypertension; the tension of the brachial artery varied from 10 to 19.5 and that of the retinal artery from 75 to 170. The pressure of the central retinal vein was 80 mm. of mercury.

In the second case there was no general hypertension; the tension of the brachial artery varied from 8.5 to 13.5, but, on the other hand, there was marked hypertension of the retinal artery, from 25 to 85. The pressure of the central retinal vein was 45 mm. of mercury.

In the first case the mechanical factors played the main role. Hypotensive and vasodilative treatment was indicated.

In the second case the mechanical factors played only a subordinate role, the hematologic and vascular factors being in the foreground. Treatment should be anticoagulative and antiseptic. The use of vasodilators would be harmful.

The prognosis was unfavorable in the first case and favorable in the second case.

RETINAL CYST (Lantern Slides). P. VEIL, Paris; L. GUILLAUMAT, Paris, and L. PETRIGNANI, Beauvais.

The authors report the observation of a retinal cyst the evolution of which could be followed ophthalmoscopically from its formation to its rupture. The patient was a woman aged 30, afflicted in one eye with hypertensive iridocyclitis and in the other eye with descemetitis and excavation of the optic disk, the retina being normal without any cystic formation. The inferotemporal cyst of the left eye, which was emmetropic, appeared without traumatism. The cyst was globular and had smooth walls and a clearly marked contour. It was translucent and fixed and differed in appearance from a retinal pocket due to detachment. Its progress to rupture in the vitreous proves its cystic nature. Rupture did not bring about retinal detachment. In fact, the latter is considered by Wevé to be the result of such cysts.

RELATION OF DETACHMENT OF THE RETINA TO CIRCULATORY DISTURBANCES OF THE CHOROID (Lantern Slides). E. REDSLOB and J. NORDMANN, Strasbourg.

The authors report a case of orbital osteoma in which the growth had produced an enormous stasis of the choroidal veins. At the precise point where dilatation of the veins attains its maximum there were detachment of the retina and polycystic retinomalacia.

Observations made on the eyeballs of dogs in which a vortex vein had been ligated were also reported. The stasis of the choroidal veins was extensive and led to retinal and choroidal detachment and to degeneration of the retina.

It has thus been shown that in a previously healthy eye congestion of choroidal veins can cause cystic degeneration of the retina and detachment. Insufficiency of arterial circulation seems to lead to the same result, so that the huge majority of idiopathic or secondary detachments of the retina should be related to disturbances of choroidal circulation.

OXYCEPHALY AND ATROPHY OF THE OPTIC NERVE (Lantern Slides). PIERRE GORSE and LOUIS CALMETTES, Toulouse.

In connection with a case of oxycephaly the authors call attention to the various pathogenic factors invoked to explain the atrophy of the

optic nerve usually observed in such patients. The atrophy in cases of oxycephaly is almost always of the postneuritic type, which there is a tendency to consider as due to papillary stasis, a consequence of intracranial hypertension.

In the case reported the atrophy was of the primary type. The authors admit the undeniable influence of cranial hypertension, but give an important role to the other possible causes, such as the compression and elongation of the optic nerve within the cranium or the optic foramen and even its toxic-infectious effect.

They think that even in a case of postneuritic atrophy in which the role of papillary stasis appears primary one should not set aside the other factors.

COMPARISON OF THE HISTOLOGIC PICTURE OF CERTAIN ORBITAL TUMORS OF LACRIMAL ORIGIN WITH THAT OF THE SO-CALLED "MIXED" TUMORS OF THE SALIVARY GLANDS (Lantern Slides). H. TILLÉ and J. LEROUX-ROBERT, Paris.

The authors describe 15 glandular epitheliomas of the orbit, selected from 45 primary tumors of the orbit classified up to the present time as epitheliomas, fibroblastic sarcomas, round cell sarcomas, endotheliomas and, above all, cylindromas. They classify them anew, taking inspiration from the labors of Leroux on the so-called "mixed" tumors. The lacrimal glands, the aberrant glands scattered in the orbit and the conjunctiva form a part of the same regional system as the organic or submucous pituitary and salivary glands. Histologically, the difference in the structure of the tumors considered is explained, on the one hand, by the differentiation and lack of differentiation and the metaplasia of epithelial elements and, on the other hand, by the epitheliocon junctival interaction and the inversion of secretory polarity.

In short, among the 45 primary tumors of the orbit, they found 5 acinous forms, 8 acinocanalicular forms, 1 vegetative canalicular form and 1 canalicular form with eosinophilic muciparous cells. The pure acinous forms, and especially the atypical and deviating forms, seem to them to have a more unfavorable prognosis than the acinocanalicular forms, the latter having a prognosis similar to that of the so-called "mixed" tumors. The group of glandular epitheliomas described by the authors is to them by far the most frequent and important of the primary tumors of the orbit.

HEXAMETHYLENETETRAMINE (METHENAMINE) IN OCULAR THERAPY. L. GRELAULT, Paris.

Grelault reports the results obtained with injections of hexamethylenetetramine (methenamine) into the polar or limbic region combined with instillations or baths of the same substance. Hexamethylenetetramine, by its antivirus properties and its great diffusibility, which permits it to penetrate impervious systems (cerebrospinal cavity and ocular cavity), is, according to the author, a valuable agent in ophthalmologic therapy. Its use is indicated for all the chorioretinal diseases, iritis, iridochoroiditis, lymphocytosis of the vitreous body, episcleritis, corneal

lesions, virus diseases, herpes zoster and trachoma. (The treatment is given in cases of trachoma by a special technic.)

Grelault believes hexamethylenetetramine to be a therapeutic agent of the first order, worthy of the whole attention of ophthalmologists, its curative effect being achieved by stages of regular and important improvement.

PITTSBURGH OPHTHALMOLOGICAL SOCIETY

EDWARD STIEREN, M.D., *President*

Oct. 24, 1938

GEORGE H. SHUMAN, M.D., *Secretary*

LOUIS STATTI, M.D., *Reporter*

DIFFUSE ORBITAL OSTEOMA: REPORT OF A CASE. DR. ADOLPH KREBS.

Miss R. H., aged 35, was seen on Jan. 7, 1936, because of protrusion of the right eye of two weeks' duration. There had been no subjective symptoms, and she had had no illness. The exophthalmometer showed the right eye to measure 23 mm. and the left eye, 19 mm. The proptosis of the right eye increased to 29 mm. within a few months. Roentgenographic study by Dr. G. W. Grier on January 15 showed extensive thickening of bone involving the roof and the external wall of the right orbit. The process extended backward and involved the floor of the frontal fossa. From the appearance of the lesion, he believed it to be an osteoma. The orbit was considerably contracted by the extensive overgrowth of bone. Roentgenographic examination on August 5 did not show any change.

At my request, the patient consulted Dr. Walter E. Dandy, who after further roentgenographic study performed an operation for the removal of a diffuse orbital osteoma on April 9, 1937. I next saw her on October 28. The right eye was still proptosed, and it pulsated synchronously with the heart beat. Exophthalmometric measurements were 29 mm. for the right eye and 20 mm. for the left eye. There was diplopia when the patient looked up or down. The media were still clear, and the fundi were normal. Vision of the right eye was 7/12—. On Jan. 6, 1938, it was 7/30. The media were still clear, and the fundi were normal. The visual field of the right eye did not show any peripheral contraction or enlargement of the blindspot, but there was a relative central scotoma for colors.

A second operation was performed by Dr. Dandy in March 1938. He found nothing grossly to explain the return of the exophthalmos, but the tissue removed showed an infiltrating tumor. He found it to be one of the malignant types of dural endothelioma, the malignant nature making it most unusual. His opinion was that the prognosis was hopeless, and he stated that it was the only orbital tumor of this type that he had had.

MALIGNANT MELANOMA OF THE CILIARY BODY: REPORT OF A CASE. DR. J. CLYDE MARKEL.

A white man aged 62, a painter, was first seen on June 6, 1937, with a history of failing vision in the right eye for four months. His health always has been good, though a number of years before he had to give up painting on account of painter's colic and became a brakeman on a railroad.

There was a mature cataract in the right eye, though perception and projection of light were good. The right pupil was slightly oval but active to light. Vision of the left eye equaled 20/40, with improvement to 20/20 with a low correction. Lenses were prescribed, and the patient was told to report in the fall.

Examination of the eyes on November 16 showed a leash of dilated vessels in the conjunctiva at the lower nasal limbus. At this same area there was a small linear black mass 2 by 0.5 mm., causing a slight fold in the iris, with fine new vessels over the surface. Transmission of light over this area was poor on transillumination. Intraocular tension was not raised. A diagnosis of melanosarcoma of the choroid was made, and immediate enucleation was urged. Dr. Curry concurred in the diagnosis. The patient decided to think it over and did not return until December 7, when the mass appeared to be slightly larger, and there was some pain. Simple enucleation was done on December 16, avertin being used for anesthetization.

According to the pathologic report, made by Capt. Elbert Decoursey, of the Army Medical Museum, the tumor consisted of an irregularly pigmented mass measuring about 1.5 mm. in diameter and extending from the ciliary body to the equator. Microscopic examination showed the tumor to extend almost to the angle of the anterior chamber and apparently to originate in the ciliary body. It had grown inward to press on the lens and invade the retina, causing detachment. The growth was composed of closely packed, moderately small cells with vesicular nuclei, prominent nucleoli and a moderate amount of cytoplasm. Pigment generally appeared only in large masses around the vascular portions. There were occasional small areas of necrosis, with little or no round cell infiltration. According to the Callender-Wilder classification, the tumor consisted of somewhat less than 50 per cent argentophilic fibers. The uninvolved ciliary processes showed some hyalinization. The lamina cribrosa was not depressed. The lens showed irregular cortical degeneration, and where it approximated the tumor exhibited a thickened capsule. The nucleus of the lens had been pushed out of line. The diagnosis was malignant melanoma of the ciliary body of the small epithelioid cell type, and traumatic cortical and equatorial capsular cataract secondary to pressure of the tumor mass.

DYSTROPHIA MESODERMALIS CONGENTIA, TYPUS MARFAN: REPORT OF A CASE. DR. EDWARD STIEREN.

A woman aged 35 had strongly contracted pupils, iridodonesis and dislocation of both crystalline lenses upward and inward. The lenses were opaque, the patient being able to see in the area above the dislocation with + 12 D. lenses. The pupils would not dilate with any mydriatic. The patient was abnormally tall, 5 feet and 11 inches (180

cm.), with long narrow feet and hands. Her emaciated appearance was due to a universal absence of subcutaneous fat, and the breasts were entirely flat. A diagnosis of arachnodactylia was made from the group of symptoms presented by the patient and first described by Marfan in 1896, known as Marfan's syndrome.

HERPETIC IRITIS WITH NEUROPATHIC KERATITIS: REPORT OF A CASE. DR. GEORGE H. SHUMAN.

Dr. W., aged 73, was first seen on Feb. 3, 1937. He had not been well for several months. In the preceding January he had been confined to bed with so-called "flu," severe bronchitis and a profuse discharge from the nose. The highest temperature recorded was 101 F. In the early morning of February 2 he was aroused by a severe pain in the right eye accompanied by a feeling of scratchiness. When he was seen on the morning of February 3, he had a severe ocular pain; practically the entire cornea, except for a narrow margin at the periphery, was covered with rather gross filaments and shreds of epithelium, yet none of the involved area stained well with fluorescein, a finding which is not unusual in the so-called dystrophic disturbances of the cornea. Biomicroscopic examination did not give any additional information of value on the superficial aspect of the cornea, but it did disclose numerous large folds in Descemet's membrane, greatly increased albumin content of the aqueous, which was literally swarming with inflammatory cells, and absence of the convection current. Scattered over the iris were small, discrete hemorrhages, situated in the stroma. It was not possible to study these hemorrhages minutely, because the clouded cornea and turbid aqueous interfered with visibility. There was neither hyphema nor hypopyon.

Based on the age of the patient (lowered vitality), the history of an antecedent febrile infection of the upper part of the respiratory tract, the severity of the iritis and the presence of interstromal hemorrhages in the iris, together with the character of the corneal involvement, a diagnosis of herpetic iritis with a complicating neuropathic keratitis was made.

When the patient was seen one week later, there was no abatement in the severity of the iritis. The appearance of the cornea had changed from that of a filamentous keratitis to an appearance characteristic of neuroparalytic keratitis; that is, there was a simple and more or less complete denudation of the epithelium over the central region involving roughly about two thirds of the corneal surface. The patient refused hospitalization until he later became irrational, partly from exhaustion due to pain and loss of sleep and possibly also from the too frequent or careless use of hyoscyamine in the eye at home. He objected to the use of atropine because of a pronounced general idiosyncrasy to it. Under rest and general care, local use of heat and bland cleansing irrigations and ointments, the cornea regained its epithelial covering in about seven weeks. The inferior half of the involved cornea became deeply infiltrated, and the central part at one time took on a yellowish appearance. A dense central scar remained to obstruct vision in the lower half of the pupillary area. The lower edge of the pupil was also obstructed by a dense synechia formed of exudate, which was also

spread over the anterior lens capsule. The biomicroscope showed a layer of dense infiltration just anterior to Descemet's membrane similar to that which persists after syphilitic interstitial keratitis. Corrected vision was 20/70. Intramuscular injections of posterior pituitary were given, with apparent benefit, for recurrent attacks of severe neuralgic pain. No other of the usual causes of iritis was found.

BILATERAL DEHISCENCE OF THE ANTERIOR LENS CAPSULE: REPORT OF A CASE. DR. JOHN B. MCMURRAY.

Mr. E. H., aged 50, a steel worker for many years, was hospitalized on Feb. 22, 1937, because of a severe zoster ophthalmicus on the right side. He remained in the hospital for fifty-six days. He consulted me on November 27 on account of severe almost continuous pain over and in the right eye. This pain was undoubtedly due to the attack of zoster ophthalmicus. In examining the eye, however, I found that he had an exfoliation of the anterior capsule of the right lens. This was an octagonal-shaped leaf of exfoliation, with its base toward the temporal side. In the left eye he had the same condition of the anterior capsule. There was a large leaf that was turned to the nasal side. The vision in the right eye was reduced to 20/200 and could not be improved. In the left eye the vision was 20/50, and with a + 0.75 sphere it was improved to 20/40. The tension with the Schiötz tonometer was 15 mm. in either eye. The visual fields were normal. The last time I examined the patient, on Oct. 17, 1938, I found the exfoliation to be just about the same as at the former examination. The tension and the visual fields were normal. The vision was the same as at the first examination.

Book Reviews

Allergische Augenerkrankungen. By Prof. Arnold Loewenstein, Prague. Price, 4.10 marks. Pp. 72. Basel: S. Karger, 1938.

In this treatise, issued as a supplement to the current volume of the *Zeitschrift für Augenheilkunde* (Kuhnt and von Michel), an introductory chapter is devoted to a general consideration of the factors, offensive and defensive, which play a part in allergic reactions and to definition of the terms and concepts applied. The author then considers, in turn, ophthalmic allergic reactions due to the instillation into the conjunctival sac of such medicaments as atropine, scopolamine and physostigmine and certain excipient vehicles, such as petrolatum and sesame oil; to matter unintentionally involving the skin of the lids or the conjunctiva such as toxic (sic) menstrual, fish or cat's blood, dust, dander, feathers and animal, plant and flower "hairs," and to substances which have a general injurious effect in addition to a local reaction, such as substances which give rise to industrial idiosyncrasies, cutaneous allergies and allied conditions. There is a chapter on the determination of the allergen by instillations of the antigen into the conjunctival sac (Dunbar, by means of the nasal test [Urbach; Gutmann]) and by cutaneous (the Jadassohn-Bloch patch test) and intracutaneous tests. A number of clinical forms are described and discussed, including the ocular complications of hay fever, its etiology and treatment, vernal catarrh, experimental anaphylactic keratitis, familial corneal degeneration, the "moon blindness" of horses and allergic inflammation of the sclera, iris and ciliary body. The author is not convinced of the allergic nature of sympathetic ophthalmia and endophthalmitis phacoanaphylactica.

PERCY FRIDENBERG.

Die Veraetzungen des Auges. By Dr. Oskar Thies, Dessau. Price, brochure, 4.60 marks. Pp. 103, with 36 illustrations. Stuttgart: Ferdinand Enke, 1938.

In a thoroughly documented and copiously illustrated monograph, which appears as a supplement to the *Klinische Monatsblätter für Augenheilkunde*, the author considers at length new paths in the interpretation and treatment of those chemical injuries of the eyeball and/or lids which in English medical parlance are summed up as "burns." Thies gives in detail the pathologic factors, stages, clinical course, complications and sequelae in corrosions by acids and alkalis as well as by ammonia and lime and such varied chemical products as ethereal oil, aniline dyes, alcohol, combat gases and metallic compounds. There is an excellent chapter on first aid and immediate treatment by irrigation, neutralization and protection and the early surgical restoration by means of skin and/or buccal mucous membrane grafts. The work is thorough, like most German treatises, and, like them, it practically ignores the publications of American and English ophthalmic surgeons.

PERCY FRIDENBERG.

Zur Pathologischen Anatomie und Therapie des Trachoms. By Prof. A. Birch-Hirschfeld, Königsberg. Price, 4.10 marks. Pp. 42, with 18 illustrations. Basel: S. Karger, 1938.

The author, noting the surprising multiplicity of clinical and histopathologic pictures in the course of trachoma, has limited himself mainly to the study and interpretation of changes in the tarsus and the tarsal conjunctiva. He considers the tissue manifestations of the later stages to be at least as distinctive and important as, for example, the various cell forms found in the infiltrated regions, the trachoma follicle or changes in the conjunctival epithelium. Thorough microscopic study of 153 excised tarsi showed in spite of a marked variation in the intensity and localization of the inflammatory and infiltrative processes that there are certain definite and characteristic changes and, essentially, correspondence in later stages. A knowledge of these factors which determine in a large measure the final condition of the lids and to some degree that of the globe is of practical significance, as they point directly toward the appropriate treatment, medical and mechanical, of trachoma in its initial stages and to early combined excision of the tarsus, when this structure has become involved. The monograph is published as a supplement to the *Zeitschrift für Augenheilkunde* (Kuhnt and von Michel).

PERCY FRIDENBERG.

The Vitamins and Their Clinical Application. By W. Stepp, J. Kühnau and H. Schroeder. Translated by Herman A. H. Bouman, M.D. Price, $4.50. Pp. 173, with a separate index. Milwaukee: The Vitamin Products Company, 1938.

This manual was published in Germany late in 1936. The translation appeared in 1938 with an appendix of 53 pages, which, according to the publishers, brings the edition up to date until October 1937.

The first 120 pages (the translation) discusses briefly for each vitamin its history, chemistry, determination, occurrence, physiology, manifestations of deficiency, supposed mode of action and, in some instances, commercial preparations and dosage. The authors have assembled a mass of information in a few pages. If one remembers that this portion of the book covers the field only up to 1937, it can be said that it furnishes a compact body of data and an adequate bibliography.

The appendix, on the other hand, seems superfluous. Fifteen pages are devoted to outlines of the apparent function, possible results of deficiency and results of absence of each vitamin.

The separate bibliography of the appendix is imposing with over 680 references. However, 337 of these refer to the same 12 sources, so that the bibliography is at least twice as long as is necessary. Five of these 12 sources are textbooks which are, after all, secondary or tertiary sources of information.

WALTER F. DUGGAN.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Dr. P. Bailliart, 66 Boulevard Saint-Michel, Paris, 6e, France.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.
All correspondence should be addressed to the Secretariat, 66 Boulevard Saint-Michel, Paris, 6e, France.

International Ophthalmologic Congress

President: Prof. Nordenson, Serafimerlasarettet, Stockholm, Sweden.
Secretary: Dr. Ehlers, Jerbanenegade 41, Copenhagen, Denmark.

International Organization Against Trachoma

President: Dr. A. F. MacCallan, 33 Welbeck St., London, W., England.

FOREIGN

All-India Ophthalmological Society

President: Dr. B. K. Narayan Rao, Minto Ophthalmic Hospital, Bangalore.
Secretary: Dr. G. Zachariah, Flitcham, Marshall's Rd., Madras.

British Medical Association, Section on Ophthalmology

President: Dr. Stewart Duke-Elder, 59 Harley St., London, W. 1.
Secretary: Dr. Thomasina Belt, 13 Mitchell Ave., Jesmond, Newcastle-on-Tyne.

Chinese Ophthalmology Society

President: Dr. C. H. Chou, 363 Avenue Haig, Shanghai.
Secretary: Dr. F. S. Tsang, 221 Foochow Rd., Shanghai.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen, Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

German Ophthalmological Society

President: Prof. W. Lohlein, Berlin.
Secretary: Prof. E. Engelking, Heidelberg.

Midland Ophthalmological Society

President: Dr. W. Niccol, 4 College Green, Gloucester, England.
Secretary: T. Harrison Butler, 81 Edmund St., Birmingham, England.
Place: Birmingham and Midland Eye Hospital.

Ophthalmological Society of Egypt

President: Prof. Dr. Mohammed Mahfouz Bey, Government Hospital, Alexandria.
Secretary: Dr. Mohammed Khalil, 4 Baehler St., Cairo.
All correspondence should be addressed to the Secretary, Dr. Mohammed Khalil.

Ophthalmological Society of the United Kingdom

President: Mr. T. Harrison Butler, 81 Edmund St., Birmingham, England.
Secretary: Mr. L. H. Savin, 7 Queen St., London, W. 1.
Time: April 20-22, 1939.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4, India.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14, India.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Oxford Ophthalmological Congress

Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Time: July 6-8, 1939.

Palestine Ophthalmological Society

President: Dr. Arieh Feigenbaum, Abyssinian Str. 15, Jerusalem.
Secretary: Dr. E. Sinai, Tel-Aviv.

Polish Ophthalmological Society

President: Dr. W. Kapuściński, 2 Waly Batorego, Poznań.
Secretary: Dr. J. Sobański, Lindley'a 4, Warsaw.
Place: Lindley'a 4, Warsaw.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Malcolm Hepburn, 111 Harley St., London, W. 1, England.
Secretary: Dr. C. Dee Shapland, 15 Devonshire Pl., London, W. 1, England.

Société Française d'Ophtalmologie

Secretary: Dr. René Onfray, 6 Avenue de la Motte Picquet, Paris, 7e.

Society of Swedish Ophthalmologists

President: Prof. K. G. Ploman, Stockholm.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö.

Tel-Aviv Ophthalmological Society

President: Dr. D. Arieh-Friedman, 96 Allenby Str., Tel-Aviv, Palestine.
Secretary: Dr. Sadger Max, 9 Bialik Str., Tel-Aviv, Palestine.

Tsinan Ophthalmological Society

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung, China.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. S. Judd Beach, 704 Congress St., Portland, Maine.
Secretary: Dr. Derrick T. Vail Jr., 441 Vine St., Cincinnati.
Place: St. Louis. Time: May 15-19, 1939.

American Academy of Ophthalmology and Otolaryngology, Section on Ophthalmology

President: Dr. Harry S. Gradle, 58 E. Washington St., Chicago.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Chicago. Time: Oct. 8-13, 1939.

American Ophthalmological Society

President: Dr. Frederick Tooke, 1482 Mountain St., Montreal, Canada.
Secretary-Treasurer: Dr. Eugene M. Blake, 303 Whitney Ave., New Haven, Conn.
Place: Hot Springs, Va.

Canadian Ophthalmological Society

President: Dr. S. Hanford McKee, 1528 Crescent St., Montreal.
Secretary-Treasurer: Dr. J. A. MacMillan, 1410 Stanley St., Montreal.
Place: Montreal. Time: June 19-23, 1939.

National Society for the Prevention of Blindness

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Secretary: Miss Regina E. Schneider, 50 W. 50th St., New York.

SECTIONAL

Central Wisconsin Society of Ophthalmology and Otolaryngology

President: Dr. R. O. Ebert, 104 Main St., Oshkosh.
Secretary: Dr. G. L. McCormick, 626 S. Central Ave., Marshfield.
Place: Oshkosh. Time: May 1939.

New England Ophthalmological Society

President: Dr. Edwin B. Goodall, 101 Bay State Rd., Boston.
Secretary-Treasurer: Dr. Trygve Gundersen, 243 Charles St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. F. C. Cordes, 384 Post St., San Francisco.
Secretary-Treasurer: Dr. C. Allen Dickey, 450 Sutter St., San Francisco.
Place: San Francisco. Time: June 19-22, 1939.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. L. Goss, Cobb Bldg., Seattle.
Secretary-Treasurer: Dr. Purman Dorman, 1115 Terry Ave., Seattle.
Place: Seattle or Tacoma, Wash. Time: Third Tuesday of each month, except June, July and August.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. L. J. Friend, 425 E. Grand Ave., Beloit, Wis.
Secretary-Treasurer: Dr. Thorsten E. Blomberg, 501–7th St., Rockford, Ill.
Place: Rockford, Ill., or Janesville or Beloit, Wis. Time: Third Tuesday of each month from October to April, inclusive.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. Don M. Howell, Alma, Mich.
Secretary-Treasurer: Dr. Louis D. Gomon, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. R. A. Kelly, 304 N. Main St., Mitchell, S. D.
Secretary-Treasurer: Dr. J. C. Decker, 515 Frances Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Grady E. Clay, Medical Arts Bldg., Atlanta, Ga.
Secretary: Dr. John R. Hume, 921 Canal St., New Orleans.

Southwestern Michigan Triological Society

President: Dr. Carl Wencke, Battle Creek.
Secretary-Treasurer: Dr. A. K. Zinn, Battle Creek.
Time: Third Thursday of alternate months.

Western Pennsylvania Eye, Ear, Nose and Throat Society

President: Dr. C. M. Harris, Johnstown.
Secretary-Treasurer: Dr. C. Wearne Beals, 41 N. Brady St., DuBois.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. John C. Long, 324 Metropolitan Bldg., Denver.
Place: Capitol Life Bldg., Denver. Time: 7:30 p. m., third Saturday of each month, October to May, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. William M. Good, 63 Center St., Waterbury.
Secretary-Treasurer: Dr. S. J. Silverberg, 201 Park St., New Haven.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. Grady E. Clay, 384 Peachtree St., N. E., Atlanta.
Secretary-Treasurer: Dr. J. Mason Baird, 511 Medical Arts Bldg., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. W. Rutherford, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Marlow W. Manion, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: First Wednesday in April.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. H. Lamb, American Bank Bldg., Davenport.
Secretary-Treasurer: Dr. B. M. Merkel, 604 Locust St., Des Moines.
Place: Davenport.

Louisiana-Mississippi Ophthalmological and Otolaryngological Society

President: Dr. Francis E. Le Jeune, 632 Maison Blanche Bldg., New Orleans.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.
Place: Gulfport, Miss. Time: May 8, 1939.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. B. Fralick, 201 S. Main St., Ann Arbor.
Secretary: Dr. O. McGillicuddy, 124 W. Allegan St., Lansing.

Minnesota Academy of Ophthalmology and Otolaryngology

President: Dr. Frank N. Knapp, 318 W. Superior St., Duluth.
Secretary-Treasurer: Dr. George E. McGeary, 920 Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. Roy Grigg, Bozeman.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. Norman W. Burritt, 30 Beechwood Rd., Summit.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.
Place: Atlantic City. Time: June 1939.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. Algernon B. Reese, 73 E. 71st St., New York.
Secretary: Dr. Chester C. Cott, 333 Linwood Ave., Buffalo.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. M. Lilly, 302 Old St., Fayetteville,
Secretary-Treasurer: Dr. Frank C. Smith, 106 W. 7th St., Charlotte.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. N. A. Youngs, 322 De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, 516–6th St., Valley City.
Place: Fargo. Time: May 1939.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. L. O. Clement, 406 State St., Salem.
Secretary-Treasurer: Dr. Paul Bailey, 833 S. W. 11th Ave., Portland.
Place: Good Samaritan Hospital, Portland. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. N. Darrell Harvey, 112 Waterman St., Providence.
Secretary-Treasurer: Dr. Linley C. Happ, 124 Waterman St., Providence.
Place: Rhode Island Medical Society Library, Providence. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. S. B. Fishburne, 1430 Marion St., Columbia.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Kate Savage Zerfoss, 165–8th Ave., N., Nashville.
Secretary-Treasurer: Dr. W. D. Stinson, 805 Medical Arts Bldg., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Charles T. St. Clair, 418 Bland St., Bluefield, W. Va.
Secretary-Treasurer: Dr. M. H. Williams, 30½ Franklin Rd., S. W., Roanoke.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. George Traugh, 309 Cleveland Ave., Fairmont.
Secretary: Dr. Welch England, 621½ Market St., Parkersburg.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Andrew Rados, 31 Lincoln Park, Newark.
Secretary: Dr. William F. McKim, 317 Roseville Ave., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

Akron Academy of Ophthalmology and Otolaryngology

President: Dr. L. E. Brown, Second National Bldg., Akron, Ohio.
Secretary-Treasurer: Dr. C. R. Anderson, 106 S. Main St., Akron, Ohio.
Time: First Monday in January, March, May and November.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. J. Mason Baird, Medical Arts Bldg., Atlanta, Ga.
Secretary: Dr. Alton V. Hallum, 478 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. Time: Second Friday of each month from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Frank B. Walsh, Wilmer Institute, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. Fred M. Reese, 6 E. Eager St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Birmingham Eye, Ear, Nose and Throat Club

President: Each member, in alphabetical order.
Secretary: Dr. N. E. Miles, 408 Medical Arts Bldg., Birmingham, Ala.
Place: Tutwiler Hotel. Time: 6:30 p. m., second Tuesday of each month, September to May, inclusive.

Brooklyn Ophthalmological Society

President: Dr. E. Clifford Place, 59 Livingston St., Brooklyn.
Secretary-Treasurer: Dr. Frank Mallon, 1135 Park Pl., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Ivan J. Koenig, 40 North St., Buffalo.
Secretary-Treasurer: Dr. Meyer H. Riwchun, 367 Linwood Ave., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga, Tenn.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Georgiana Dvorak-Theobald, 715 Lake St., Oak Park, Ill.
Secretary-Treasurer: Dr. Earle B. Fowler, 55 E. Washington St., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati Ophthalmic Club

Chairman: Each member, in rotation.
Secretary-Treasurer: Dr. E. R. Thomas, 819 Carew Tower, Cincinnati.
Place: Holmes Memorial Library, Cincinnati General Hospital. Time: 8:15 p. m., third Monday of each month except June, July and August.

Cleveland Ophthalmological Club

Chairman: Dr. Paul Moore, Republic Bldg., Cleveland.
Secretary: Dr. G. Leslie Miller, 14805 Detroit Ave., Cleveland.
Time: Second Tuesday in October, December, February and April.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Clerk: Dr. W. S. Reese, 1901 Walnut St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

COLUMBUS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

Chairman: Dr. Hugh G. Beatty, 150 E. Broad St., Columbus, Ohio.
Secretary-Treasurer: Dr. W. A. Stoutenborough, 21 E. State St., Columbus, Ohio.
Place: Deshler Wallick Hotel. Time: 6 p. m., first Monday of each month.

CORPUS CHRISTI EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Edgar G. Mathis, 416 Chaparral St., Corpus Christi, Texas.
Secretary: Dr. E. King Gill, 416 Chaparral St., Corpus Christi, Texas.
Time: Second Thursday of each month from October to May.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Maxwell Thomas, Medical Arts Bldg., Dallas, Texas.
Secretary: Dr. J. Dudley Singleton, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month from September to May.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Arthur S. Hale, 1609 Eaton Tower, Detroit.
Time: 6:30 p. m., first Wednesday of each month.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. L. A. Hulsebosch, 191 Glen St., Glen Falls.
Secretary-Treasurer: Dr. Joseph L. Holohan, 330 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. R. A. Gough, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Charles R. Lees, 806 Medical Arts Bldg., Fort Worth, Texas.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

GRAND RAPIDS EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Dewey R. Heetderks, 405 Medical Arts Bldg., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 116 E. Fulton St., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. Louis Daily, 1215 Walker Ave., Houston, Texas.
Secretary: Dr. Herbert H. Harris, 1004 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. J. K. Leasure, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to June.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. E. N. Robertson, Concordia, Kan.
Secretary: Dr. John S. Knight, 1103 Grand Ave., Kansas City, Mo.
Time: Third Thursday of each month from October to June. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Ben K. Parks, 619 Professional Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. Paul Nilsson, 211 Cherry Ave., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Clifford B. Walker, 427 W. 5th St., Los Angeles.
Secretary-Treasurer: Dr. John P. Lordan, 2007 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

LOUISVILLE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Gaylord C. Hall, Brown Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Charles K. Beck, Starks Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Earle Breeding, 1801 I St., N. W., Washington.
Secretary: Dr. Elmer Shepherd, 1606–20th St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. Sam H. Sonders, Medical Arts Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. John E. Mulsow, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. John B. Hitz, 411 E. Mason St., Milwaukee.
Place: University Club. Time: 6:30 p. m., second Tuesday of each month.

MINNEAPOLIS OPHTHALMOLOGICAL SOCIETY

Chairman: Each member, in alphabetical order.
Secretary: Dr. M. C. Pfunder, 645 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

MONTGOMERY COUNTY MEDICAL SOCIETY

Chairman: Dr. P. H. Kilbourne, Fidelity Bldg., Dayton, Ohio.
Secretary-Treasurer: Dr. Maitland D. Place, 981 Reibold Bldg., Dayton, Ohio.
Place: Van Cleve Hotel. Time: 6:30 p. m., first Tuesday of each month from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. L. de G. Joubert, 690 Dunlop St., Montreal, Canada.
Secretary: Dr. K. B. Johnston, 1509 Sherbrooke St., W., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Guy Maness, 119–7th Ave., Nashville, Tenn.
Secretary-Treasurer: Dr. Andrew Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to May.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. E. G. Walls, 619 Maison Blanche Bldg., New Orleans.
Secretary-Treasurer: Dr. W. B. Clark, 1012 American Bank Bldg., New Orleans.
Place: Louisiana State University Medical Bldg. Time: 8 p. m., second Tuesday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. James W. White, 15 Park Ave., New York.
Secretary: Dr. Rudolf Aebli, 30 E. 40th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

New York Society for Clinical Ophthalmology

President: Dr. Percy Fridenberg, 38 W. 59th St., New York.
Secretary: Dr. David Alperin, 889 Park Pl., Brooklyn.
Place: Squibb Hall, 745–5th Ave. Time: 8 p. m., first Monday of each month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. Philip Romonek, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Ophthalmological Society of the University of Pittsburgh

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, 351–5th Ave., Pittsburgh.
Time: Second Monday in November, January, March and May.

Passaic-Bergen Ophthalmological Club

President: Dr. R. N. Berke, 430 Union St., Hackensack, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 340 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Walter I. Lillie, 255 S. 17th St., Philadelphia.
Secretary: Dr. Edmund B. Spaeth, 1930 Chestnut St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward Stieren, Union Trust Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, 351–5th Ave., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. N. H. Turner, 200 E. Franklin St., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Roy E. Mason, Frisco Bldg., St. Louis.
Secretary: Dr. Leslie Charles Drews, 508 N. Grand Blvd., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Oscar H. Judkins, 414 Navarro St., San Antonio, Texas.
Secretary-Treasurer: Dr. Wilfred E. Muldoon, 414 Navarro St., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Russell Fletcher, 490 Post St., San Francisco.
Secretary: Dr. Avery Morley Hicks, 490 Post St., San Francisco.
Place: Society's Bldg., 2180 Washington St., San Francisco. Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. R. R. Kirkpatrick, 6th and Walnut Sts., Texarkana, Ark.
Secretary-Treasurer: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Place: Shreveport Charity Hospital. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. P. B. Greene, 422 Riverside Ave., Spokane, Wash.
Secretary: Dr. O. M. Rott, 421 Riverside Ave., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. James F. Cahill, 428 S. Salina St., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. Herbert Katz, 713 E. Genesee St., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. A. Lloyd Morgan, 170 St. George St., Toronto, Canada.
Secretary: Dr. W. R. F. Luke, 170 St. George St., Toronto, Canada.
Place: Academy of Medicine, 13 Queens Park. Time: First Monday of each month, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. G. Victor Simpson, 1710 Rhode Island Ave., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Frank D. Costenbader, 1726 I St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.